SUGARCANE RESEARCH

Annual Progress Report

1988

LOUISIANA
AGRICULTURAL
EXPERIMENT STATION
LOUISIANA STATE UNIVERSITY AGRICULTURAL CENTER

SUGARCANE RESEARCH

ANNUAL PROGRESS REPORT

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LOUISIANA AGRICULTURAL EXPERIMENT STATION
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FOREWORD

Research on sugarcane in the Louisiana Agricultural Experiment Station is an integral part of the LSU Agricultural Center's research-extension effort to provide the knowledge and technology base for efficient production and processing of sugarcane. Sugarcane research projects are lead by scientists in the Sugar Station/Audubon Sugar Institute, and the departments of: Agricultural Economics and Agribusiness, Agricultural Engineering, Agronomy, Entomology, and Plant Pathology and Crop Physiology.

Members of the Louisiana Agricultural Experiment Station maintain close working relations with colleagues in respective departments of the College of Agriculture and other colleges of the LSU Baton Rouge campus, the Louisiana Cooperative Extension Service, the Agricultural Research Service and Soil Conservation Service of the USDA, the American Sugar Cane League, and the Louisiana Department of Agriculture.

A major portion of the resources for production and processing research are linked to the St. Gabriel Research Station and Sugar Station/Audubon Sugar Institute respectively. The Iberia Research Station helped to accomplish specific sugarcane research objectives in 1988.

An important part of the 1988 research effort was conducted on cooperating farms and in cooperating factories throughout the industry. The dwindling of farm labor supply has been making the evaluation of location effects and location interaction effects increasingly difficult. However, these evaluations are very important and must be continued. The cooperation of individual farms and sugarcane factories in conducting research projects and financial support of the American Sugar Cane League is gratefully acknowledged.

TABLE OF CONTENTS

Foreword i

Table of Contents ii

Soil Fertility Research with Sugarcane in Louisiana in 1988 1

Cultural Practice Research with Sugarcane in Louisiana in 1988 12

Sweet Sorghum for Biomass and Sugar Production in Louisiana 29

Use of Plant Analyses in Evaluating the Nitrogen, Phosphorus and Potassium Status of Plant Cane 34

Soil and Water Management 36

Sugarcane Weed Control Research 39

Sugarcane Smut and Pythium Root Rot Research 41

Sugarcane Pathology Research 43

Chemical Control of the Sugarcane Borer 46

Integration of Control Tactics for the Sugarcane Borer 48

Varietal Resistance to Diatraea Saccharalis 49

Sugarcane Borer Fecundity 51

Sugarcane Breeding Progress in 1988 53

Photoperiod and Crossing for the Year 1988 55

1988 Selections, Line Trials, and Assignments 80

Performance of Nurseries at the Iberia Research Station 106

1988 Louisiana (L) Nursery Variety Trials 110

1988 Louisiana (L) Infield Variety Trials 121

1988 LSU Outfield Variety Trials 139

Summary of Varietal Yield and Harvestability Across the 1988 Outfield Variety Trial Locations 153

Sucrose Lab Activities - 1988 Harvest Season 168

Department of Agricultural Economics and Agribusiness
Sugarcane Research Report for 1988 169

Processing and Distribution Systems for Louisiana Food
and Agricultural Products 173

Dextran Survey 1988 175

Sugar Losses Due to Cane Washing 178

Dextranase Project-Summary 181

1988 Core Sampling 183

Quick Core Laboratory Test For Dextran 194

Evaporator Scaling Studies 201

Purification of Sugarcane Process Streams 202

Vacuum Pan Automation 203

Optimization of the Performance of Low-Grade
Crystallizers in the Sugarcane Industry 219

Composition of 1988 Louisiana Final Molasses 244

Projects Supported by the American Sugar Cane
League in 1988 254

1988 Publications and Presentations 255

Soil Fertility Research with Sugarcane in Louisiana in 1988[1/]

Ray Ricaud and Allen Arceneaux
Agronomy Department

Research was continued in 1988 to determine the effects of certain fertilization practices on the yield of sugarcane in Louisiana. Experiments were conducted on fertilizer needs in a cane-wheat rotation, rates and methods of fertilizer application, fertilizers and soil pesticide needs for succession cane and rates of gypsum application. These experiments were conducted in cooperation with the St. Gabriel Research Station, Iberia Research Station and growers in the cane area.

The research was designed to provide information in an effort to help cane growers to produce maximum economic yields and to increase profitability in sugarcane production. This annual progress report is presented to provide the latest available data on certain practices and not as a final recommendation for growers to use all of these practices. Recommendations are based on several years of research data.

Fertilization in Cane-Wheat Rotation

An experiment was initiated in 1988 to test rates of fertilizers in plant cane in a cane-wheat rotation. Rates of N consisting of 60, 120 and 180 lbs/A were applied to plots with and without wheat grown during the previous fallow year. Also, a 80 lbs/A potash rate was tested at the 180 and 240 lbs/A rates of N where wheat was grown the previous year. The experiment was on a Commerce silt loam soil at the St. Gabriel Research Station.

The plant cane yield data obtained are reported in Table 1. The yield increase from 60 lbs/A of N following wheat was significant. The increases from the higher N rates over the 60 lbs/A rate were small. The wheat significantly reduced the yield of plant cane where the cane was fertilized with 60 and 180 lbs/A of N. The potash application did not increase cane yield. The reduction in yield of plant cane following a wheat crop during the fallow year was probably due to the removal of soil N by the wheat crop and by organisms in the decomposition of the wheat straw in the soil.

This research was supported in part by grant funds from Allied Corporation, Freeport Sulphur Co. and by sugarcane growers.

Rates and Methods of Fertilizer Application

An experiment was initiated in 1988 to test rates of N application on the yield of plant cane on a Commerce silt loam soil on Jerry Woods Farms in St. James Parish. The N rates were 0, 60, 120, 180 and 240 lbs/A. Variety CP 65-357 was planted on the plots and the fertilizer treatments were applied in April, 1988. The plant cane yield data obtained in November are reported in Table 2. Significant increases were obtained in cane yield from each N rate and in sugar yield from the 120, 180 and 240 N rates over the check plot. The differences in cane yield above the 60 lbs/A and in sugar yield above 120 lbs/A were small. The differences in juice quality due to the N rates were small. The increases in yield were due principally to increases in stalk population at harvest time.

An experiment was continued to test rates of fertilizer application on the yield of first stubble cane on an Iberia clay loam soil at the Iberia Research Station. The fertilizer treatments consisted of 80 and 160 lbs/A of N, 0 and 60 lbs/A of phosphate and 0, 80 and 160 lbs/A of potash in all possible combinations. Variety CP 70-321 was planted on the plots and the treatments were applied in April, 1988. The first stubble yield data obtained in November are reported in Table 3. Each fertilizer treatment increased the cane and sugar yield over the check plot. The yield increases from 160 over 80 lbs/A of N in each fertilizer combination were small. The yield responses to phosphate and potash were significant with the 80-60-80, 80-60-160 and 160-60-160 treatments. The potash alone increased yield with the 80-60-80 and 160-0-80 treatments. The yield increase from 160 over 80 lbs/A potash was significant with the 160-60-160 treatment.

An experiment was conducted in 1988 to test rates and methods of fertilizer application on the yield of first stubble cane with variety CP 70-321. The extractable soil P was relatively high at this location and the fertilizer treatments consisted of 80 and 160 pounds of nitrogen and 0, 80 and 160 pounds of potash per acre. Two methods of application were tested consisting of banding the fertilizer in the off-bar furrow and broadcasting the fertilizer on the soil surface. All the treatments were applied in April, 1988. The yield data obtained are reported in Table 4. The cane yields produced with each treatment combination were significantly higher than the check plot yield. The yield increases from the 80 and 160 lbs/A of N alone were significant but the differences in yield between the N rates were small. The 80 lbs/A rate of potash increased yield with the band and broadcast 80-0-80 and the broadcast 160-0-80 treatment. The yield increases from the 160 over the 80 lbs. of potash were small. The differences between the band and broadcast methods of application were small.

Fertilization of Succession Cane

An experiment was continued with plant cane in 1988 from succession planted sugarcane to determine the effects of applying fertilizers and Furadan nematocide in the fall and spring on cane yield. This test was planted in 1987 in succession following a three-year cycle of cane which was also planted in succession with a previous cane crop in 1984. The fertilizer and Furadan treatments applied in this plant cane test were the same as those applied in the first cycle of succession cane. The treatments consisted of a fall application of 0-0-0 and 90-90-90 fertilizer at planting time and a spring application of 120-0-80 and 240-0-160 fertilizers in each crop year. Furadan at a rate of 10 lbs/A was applied at planting time and in the spring of each crop year.

The data obtained in 1988 with plant cane are reported in Table 5. The application of a 90-90-90 fertilizer at planting time in 1987 increased cane yield only where Furadan was not applied. The differences in yield between the 120-0-80 and 240-0-160 treatments applied in the spring of 1988 were small. The average yield increases from Furadan were 5.1 T/A without fall applied fertilizer and 1.8 T/A with fall fertilizer. The fall fertilizer increased yield without applied Furadan and Furadan increased yield without applied fall fertilizer.

An experiment was continued in 1988 with succession and fallow planted sugarcane to determine the effects of fertilizers, a nematocide and a fungicide on the yield of second stubble cane. The test was initiated with cane variety CP 70-321 on a Commerce silt loam soil located on the St. Gabriel Research Station in 1986. The fertilizer treatments consisted of a fall application of 0-0-0 and 90-90-90 fertilizer with succession cane and a spring application of 120-0-80 and 240-0-160 fertilizers with fallow and succession planted cane. Furadan nematocide at 10 lbs/A was applied in the fall and spring and Ridomil fungicide at 1/2 pint/A was applied only in the spring. The fall applications were made at planting time in 1985 and the spring applications were made in April of 1986, 1987 and 1988.

The data obtained in second stubble cane are reported in Table 6. The increases in cane yield from a 90-90-90 applied at planting time were significant with 120-0-80 applied in spring in succession cane. These increases occurred only where Furadan was not applied. The differences in yield between the 120-0-80 and 240-0-160 fertilizers applied in the spring were small. The yield increase from Furadan was significant only in succession cane without a fall fertilizer applied. The use of Ridomil did not increase yield in this test. The succession cane produced slightly less yield without the fall fertilizer, but produced yield similar to the fallow cane with a fall fertilizer. Apparently, succession cane needs a fertilizer application in the fall at planting time or Furadan in the fall and spring of each crop year to produce normal yields.

Gypsum Test

A test was continued with second stubble cane in 1988 to determine the effects of applied by-product gypsum on soil properties and cane yield on a Sharkey clay soil at Cinclare Plantation in West Baton Rouge Parish. The rates of by-product gypsum tested were 0, 1, 2, 5 and 10 tons per acre of Fluorogypsum and 5 tons per acre of Phosphogypsum. The gypsum was broadcasted with a fertilizer spreader and mixed into the topsoil with the use of a rototiller prior to planting cane variety CP 72-356 in the fall of 1985. The plots were harvested as plant cane in 1986, first stubble in 1987 and second stubble in 1988. The second stubble data are reported in Table 7. The yield increase from each gypsum treatment over the check plot was significant. The yield increases from the 2-, 5- and 10-ton/A rates were similar and significantly larger than with the 1-ton rate. The difference in yield between the Fluorogypsum and Phosphogypsum at the 5-ton rate was small. The yield increases were due mainly to increases in stalk population. The unusual over-all low cane yields in this test was apparently due to moisture stress during a dry period in the summer of 1988.

Table 1. Effect of rate of fertilizer application on the yield of plant cane following a wheat crop on a Commerce silt loam soil at the St. Gabriel Research Station, 1988.

Fertilizer applied $N-P_2O_5-K_2O$	Previous crop	Plant cane yield	Stalk		Normal juice		Sugar yield
			No.	Wt.	Brix	Sucrose	
lbs/A		T/A	1000/A	lbs.	%	%	lbs/A
0-0-0	Wheat	24.5	20.8	2.56	18.1	15.3	5446
60-0-0	Fallow	32.8	32.5	2.57	18.0	15.4	7299
60-0-0	Wheat	30.4	29.4	2.66	17.9	14.9	6535
120-0-0	Fallow	30.8	31.5	2.69	18.1	15.3	6847
120-0-0	Wheat	29.5	26.0	2.60	18.3	15.4	6587
180-0-0	Fallow	31.5	32.0	2.53	18.1	15.3	6970
180-0-0	Wheat	28.1	29.9	2.71	17.9	15.0	6095
180-0-80	Wheat	31.2	30.1	2.79	18.4	15.6	7074
240-0-80	Wheat	31.9	28.6	2.72	18.0	15.1	6956
LSD .05		1.7	3.1	NS	NS	NS	581

The wheat plots were harvested in May and the cane was planted in September, 1987. The fertilizer experiment was conducted with variety CP 76-331 and the cane was fertilized in April and harvested in December, 1988. The fertilizer treatments were applied in a band in the off-bar furrows.

Table 2. Effect of rate of nitrogen fertilizer application on the yield and yield components of plant cane on a Commerce silt loam soil on Jerry Woods Farms in St. James Parish, 1988.

Fertilizer applied $N-P_2O_5-K_2O$	Plant cane yield	Stalk		Normal juice		Sugar yield
		No.	Wt.	Brix	Sucrose	
lbs/A	T/A	1000/A	lbs.	%	%	lbs/A
0-0-0	37.1	35.9	2.07	17.2	13.8	7269
60-0-0	40.6	38.0	2.14	17.1	13.7	7886
120-0-0	40.5	38.3	2.12	17.5	14.1	8152
180-0-0	40.2	36.8	2.19	17.9	14.4	8301
240-0-0	40.7	38.3	2.12	17.7	14.3	8273
LSD .05	2.9	1.7	0.11	NS	NS	650

The experiment was conducted with variety CP 65-357 and the cane was fertilized in April and harvested in November, 1988.

Table 3. Effect of rate of fertilizer application on the yield and yield components of first stubble cane on an Iberia clay loam soil at the Iberia Research Station, 1988.

Fertilizer applied $N-P_2O_5-K_2O$	Stubble cane yield	Stalk		Normal juice		Sugar yield
		No.	Wt.	Brix	Sucrose	
lbs/A	T/A	1000/A	lbs.	%	%	lbs/A
0-0-0	21.2	21.7	1.95	15.3	12.0	3505
80-0-0	41.2	31.8	2.60	15.4	11.7	6611
80-60-0	39.7	31.8	2.50	15.8	12.0	6545
80-0-80	42.5	31.3	2.72	15.3	11.8	6915
80-60-80	45.8	31.6	2.91	15.3	11.7	7372
80-0-160	44.3	32.3	2.74	15.5	12.1	7427
80-60-160	43.2	32.6	2.66	15.4	12.0	7119
160-0-0	38.4	30.5	2.52	15.7	12.0	6379
160-60-0	39.7	30.2	2.63	15.6	11.9	6503
160-0-80	44.4	32.9	2.70	15.4	12.0	7347
160-60-80	39.3	31.7	2.48	15.7	12.2	6639
160-0-160	39.9	31.6	2.53	15.3	11.8	6490
160-60-160	43.4	32.4	2.68	15.6	12.1	7255
LSD .05	2.3	2.4	0.27	0.5	NS	561

The experiment was conducted with Variety CP 70-321 and the cane was fertilized in April and harvested in December, 1988.

The extractable soil K, Ca, Mg and P were 227, 2996, 698 and 181 ppm, respectively, with a soil organic matter of 1.52% and pH 6.0.

Table 4. Effect of rate and method of fertilizer application on the yield and yield components of first stubble cane on a Commerce silt loam soil at the St. Gabriel Research Station, 1988.

Fertilizer applied $N-P_2O_5-K_2O$	Method of application	Stubble cane yield	Stalk		Normal juice		Sugar yield
			No.	Wt.	Brix	Sucrose	
lbs/A		T/A	1000/A	lbs.	%	%	lbs/A
0-0-0	-	18.4	22.0	1.68	16.7	13.8	3606
80-0-0	Band	25.4	34.5	1.96	16.8	13.8	4984
80-0-80	Band	28.0	31.7	2.02	16.7	13.6	5409
80-0-80	BC	28.1	32.5	2.05	16.3	13.1	5164
160-0-0	Band	26.7	32.7	1.92	16.8	13.8	5225
160-0-0	BC	26.0	31.6	1.82	17.0	14.0	5189
160-0-80	Band	28.4	32.2	1.96	17.3	14.4	5865
160-0-80	BC	29.9	32.6	1.99	16.6	13.5	5735
160-0-160	Band	30.4	33.8	1.96	16.2	13.4	5753
160-0-160	BC	28.8	35.0	2.14	16.4	13.5	5486
LSD .05		2.6	4.5	0.32	1.0	1.1	627

BC = Broadcast

The experiment was conducted with variety CP 70-321 and the cane was fertilized in April and harvested in December, 1988. The band application was made in the off-bar furrow and the broadcast application was made on the entire soil surface of the plot.

The extractable soil K, Ca, Mg and P were 148, 1591, 368 and 311 ppm, respectively, with a soil organic matter of 0.94% and pH 7.1.

Table 5. Effect of fall and spring applications of fertilizers and Furadan nematocide on the yield and yield components of plant cane from planting in succession without a fallow year on Commerce silt loam soil at the St. Gabriel Research Station, 1988.

Fertilizer $N-P_2O_5-K_2O$		Plant cane	Stalk		Normal juice		Sugar
Fall	Spring	yield	No.	Wt.	Brix	Sucrose	yield
lbs/A	lbs/A	T/A	1000/A	lbs.	%	%	lbs/A
			Succession - No Furadan				
0-0-0	120-0-80	25.6	22.4	2.48	17.1	14.3	5247
	240-0-160	25.6	21.1	2.42	17.4	14.5	5304
90-90-90	120-0-80	27.7	23.0	2.42	17.3	14.3	5683
	240-0-160	28.3	24.1	2.28	17.4	14.5	5848
No Furadan Mean		26.8	22.6	2.40	17.3	14.4	5611
			Succession - 10 lbs. Furadan				
0-0-0	120-0-80	31.5	26.1	2.49	17.1	14.4	6526
	240-0-160	30.0	23.0	2.53	17.3	14.4	6190
90-90-90	120-0-80	28.8	25.2	2.67	17.2	14.3	5894
	240-0-160	30.9	23.0	2.75	17.2	14.3	6325
Furadan Mean		30.3	24.3	2.61	17.2	14.4	6234
LSD .05 treatment		1.4	3.3	0.26	NS	NS	718
LSD .05 Furadan		0.7	1.7	0.13	NS	NS	359

The succession cane was planted immediately following a harvested crop of second stubble cane in 1987. Cane variety CP 70-321 was planted in the test and the fall fertilizer and Furadan treatments were applied at planting time. The spring fertilizer and Furadan treatments were applied in April and the cane was harvested in November, 1988.

The extractable soil K, Ca, Mg and P were 117, 2036, 360 and 106 ppm, respectively, with a soil organic matter of 0.99% and pH 6.2.

Table 6. Effects of fall and spring applications of fertilizers, Furadan nematocide and Ridomil fungicide on the yield of second stubble from plant cane planted on fallow land and in succession with another crop on Commerce silt loam soil at the St. Gabriel Research Station, 1988.

Fertilizer $N-P_2O_5-K_2O$		Soil pesticide	Stubble cane	Stalk		Normal juice	Sugar
Fall	Spring	treatment	yield	No.	Wt.	sucrose	yield
------lbs/A-------			T/A	1000/A	lbs.	%	lbs/A
			Fallow planted cane				
0-0-0	120-0-80	Check	32.1	33.1	2.23	12.8	5750
0-0-0	120-0-80	Ridomil	32.8	32.8	2.14	13.2	6073
0-0-0	120-0-80	Furadan	32.9	32.5	2.16	13.9	6482
0-0-0	240-0-160	Furadan	33.3	35.0	2.35	13.6	6375
			Succession planted cane				
0-0-0	120-0-80	Check	29.8	32.8	2.31	13.8	5818
0-0-0	120-0-80	Ridomil	29.5	31.1	2.10	13.7	5705
0-0-0	120-0-80	Furadan	32.5	34.4	2.29	13.3	6077
0-0-0	240-0-160	Furadan	32.7	31.7	2.48	13.4	6170
90-90-90	120-0-80	Check	33.8	34.0	2.28	13.1	6217
90-90-90	120-0-80	Ridomil	32.4	34.4	2.22	14.2	6518
90-90-90	120-0-80	Furadan	34.1	35.4	2.29	13.3	6353
90-90-90	240-0-160	Furadan	33.1	34.3	2.38	13.4	6277
LSD .05			2.3	5.2	0.17	1.1	678

The fallow cane was planted after a year without growing a crop and the succession cane was planted immediately after harvesting a cane crop in 1985. Cane variety CP 70-321 was planted in the test and the fall fertilizer and Furadan were applied at planting time. The spring fertilizer, Furadan and Ridomil were applied in April and the cane was harvested in November, 1986, 1987, and 1988. Application rates were 10 lbs/A Furadan and ½ pint/A of Ridomil.

The extractable soil K, Ca, Mg and P were 62, 1566, 277 and 249 ppm, respectively, with soil organic matter of 1.4% and pH 6.8.

Table 7. Effect of rates of by-product gypsum on yield components of second stubble cane on a Sharkey clay soil at Cinclare Plantation in West Baton Rouge Parish, 1988.

By-product gypsum applied 1/	Stubble cane yield	Millable stalk		Normal juice		Sugar yield
		No.	Wt.	Brix	Sucrose	
T/A	T/A	1000/A	lbs.	%	%	lbs/A
0	7.0	7.6	1.67	15.9	11.9	1143
1	8.9	9.3	1.69	15.8	11.7	1426
2	11.7	13.2	1.77	15.3	11.0	1722
5	12.7	12.6	1.87	15.5	11.5	2007
5 P	14.0	13.9	1.86	15.5	11.3	2153
10	13.5	13.6	1.84	15.5	11.3	2072
LSD .05	1.6	2.8	0.14	NS	0.8	240

1/ Fluorogypsum was used for all treatments except phosphogypsum was used for the 5 P treatment for comparison purposes. The gypsum treatments were applied broadcasted and disked into the soil prior to planting in 1985.

Cultural Practice Research with Sugarcane in Louisiana in 1988[1/]

Ray Ricaud and Allen Arceneaux
Agronomy Department

Research was continued in 1988 to determine the effects of certain cultural practices on the yield of current varieties of sugarcane in Louisiana. Experiments were conducted on methods and rates of planting, dates of planting and harvest, cane stubble protection, stubble cane longevity and a cane stubble digger. These experiments were conducted in cooperation with the St. Gabriel Research Station.

The research was designed to provide information in an effort to help cane growers to produce maximum economic yields and to increase profitability in sugarcane production. This annual progress report is presented to provide the latest available data on certain practices and not as a final recommendation for growers to use all of these practices. Recommendations are based on several years of research data.

The temperatures during the winter months prior to the 1988 crop were mild and good cane stands occurred in early spring in most of the tests. A drought period during the summer apparently did not reduce cane yields.

Methods and Rates of Planting

An experiment was conducted with plant cane to determine the effects of widths of planting furrow and rates of planting on the yield of cane varieties CP 70-321 and CP 74-383. The furrow widths were 15 and 24 inches and the rates of planting were two and four stalks in continuous lines on a standard row spacing. A two-stalk rate in a V-furrow was planted with each variety as a check plot. The yield data obtained in this test are reported in Table 1.

The increases in cane yield with each drill width over the V-furrow were significant with both varieties except with two-stalks rate in a 24-inch width in Variety CP 74-383. The differences in yield between the 15- and 24-inch drill widths were small with each variety. The yield increases from the four-stalk over the two-stalk rate were significant with 15-inch width in CP 70-321 and 24-inch width in CP 74-383. The differences obtained in cane yield were principally due to differences in stalk population at harvest time. The drill

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This research was supported in part by grant funds from the American Sugarcane League.

widths and planting rates did not affect the sugar concentration in each variety.

Another experiment was continued in 1988 from a plant cane test initiated in 1987 to determine the effects of widths of planting furrow and rates of planting on the yield of first stubble cane. The treatments were the same as in the plant cane described above. The first stubble data reported in Table 2 show that the differences in cane yield between drill widths and planting rates with CP 72-370 were small. The yield increases were significant from the 15- and 24-inch widths with the four-stalk rate of planting over the V-furrow with CP 76-331. The four-stalk rate increased yield over the two-stalk rate only with CP 76-331 planted in the 24-inch drill width.

Date of Planting

An experiment was initiated to determine the effects of planting dates on the plant cane yield of four current varieties of sugarcane. The dates tested were September 4, October 1 and November 2 and the varieties were CP 70-321, CP 72-370, CP 74-383 and CP 76-331. The varieties were planted on each date in 1987 and harvested as plant cane in December, 1988. The data obtained are reported in Table 3. Variety CP 70-321 produced more cane yield when planted in October than November and CP 72-370 produced more cane when planted in September than November. Variety CP 74-383 produced more cane when planted in October than September and CP 76-331 produced more when planted in October and November than September. As an average of varieties, more cane yield was produced from the October planting than the other months.

Another test was continued in 1988 from plant cane in 1987 to determine the effects of planting dates on the first stubble yield of four cane varieties. The dates were September 2, October 6 and November 1 and the varieties were CP 70-321, CP 72-370, CP 74-383 and CP 76-331. The varieties were planted on each date in 1986 and harvested as plant cane in 1987 and as first stubble in 1988. The yield data obtained with first stubble are reported in Table 4. Each variety produced more first stubble cane when the plant cane was planted in October and November than in September. As an average of varieties, the October planting produced more stubble cane than the September and November plantings.

Date of Harvest

Experiments were conducted on date of harvesting four current varieties of sugarcane. One test was initiated in 1987 to determine the effects of harvesting plant cane on the yield of the following first stubble crop in 1988. Plant cane of varieties CP 70-321, CP 72-370, CP 74-383 and CP 76-331 was harvested on September 4, October 1, November 2 and December 1 in 1987. All the plots in first stubble was harvested on one date

in November, 1988 and the stubble yield data are reported in Table 5. The effects of date of harvesting plant cane on yield of the following first stubble crop were small with variety CP 70-321. The October date produced less yield than the other dates with CP 72-370. The November and December dates produced the highest yield with CP 74-383 and CP 76-331. As an average of varieties, the October harvest date for plant cane produced the lowest and the December date produced the highest stubble cane yield. The plant cane harvest dates did not affect the juice quality of the stubble cane.

Another test was initiated to determine the effects of date of harvesting plant cane on the yield of plant cane in 1988 and first stubble cane in 1989. Plant cane of varieties CP 70-321, CP 72-370, CP 74-383 and CP 76-331 was harvested on September 1, October 3, November 1 and December 1 in 1988. The data obtained for the last three harvest dates are reported in Table 6. The plant cane yield with each variety increased during October, but not during November. As an average of varieties, the increases in cane yield, stalk weight, percent sucrose and sugar yield in October and the increases in percent sucrose and sugar yield in November were significant.

Stubble Protection

An experiment was conducted on stubble protection from freeze damage to possibly increase the yield and longevity of stubble cane. The protection treatments consisted of covering the cane stubble with approximately three inches of soil after harvesting a crop and a check plot without covering. The soil cover was applied prior to the occurrence of a freeze and the cover was removed in the following spring with a stubble shaver.

Plant cane of varieties CP 65-357 and CP 72-370 was harvested on October 1, November 1 and December 1 in 1987 and the soil cover treatment was applied to the cane stubble of each variety immediately after each harvest date. The data obtained with first stubble in 1988 are reported in Table 7. The soil cover treatment did not increase cane yields with each variety and harvest date. The temperatures during the winter of 1987-88 were mild and apparently the cane stubbles did not need protection from freeze damage in this test.

Stubble Cane Longevity

A stubble longevity test was initiated with plant cane in 1985 and continued with first stubble in 1986, second stubble in 1987 and third stubble in 1988 to study the effects of cane varieties, Furadan nematocide and stubble protection on stubble crop yields. The varieties tested were CP 70-321, CP 72-370 and CP 74-383 and the Furadan rates used were 0 and 10 pounds per acre. The Furadan was applied at planting time in 1984 and in the off-bar furrow in April, 1985, 1986, 1987 and 1988. The stubble protection which consisted of covering the cane stubble

with soil after harvesting the plant cane, first stubble and second stubble crops was applied in December of each crop year. The data obtained for the third stubble are reported in Table 8. The soil cover treatment decreased cane yield with each variety in this test. This reduction in yield may be due to the possibility that the soil cover was not properly removed in the spring of 1988. As an average of varieties, the Furadan treatment significantly increased the cane yield, especially with varieties CP 72-370 and CP 74-383.

Another stubble longevity test was initiated with plant cane in 1987 and continued with first stubble in 1988. The cane varieties in this test were CP 65-357 and CP 76-331. The Furadan and cover treatments were the same as described above. The data obtained with the first stubble are reported in Table 9. The soil cover treatment in this test increased cane yield with each variety and Furadan treatment except with CP 76-331 without Furadan. As an average of the variety and cover treatments, the Furadan increased cane yield 13.6%.

Stubble Digger

Three experiments were initiated in 1988 to evaluate the use of a stubble digger to increase germination and yield of sugarcane. The experiments were located on a Commerce silt loam soil at the St. Gabriel Research Station. A rotary hoe was tested in two of the experiments for comparison purposes. The digger used has rotating tines which pivot and flip forward as they enter the ground. The rotary hoe used has fixed curved tines which is normally used to control weeds. The digger tines punched holes about 8 inches deep in the soil with much less damage to the cane stubbles than the rotary hoe. The digger and hoe treatments were made on replicated plots of several varieties of stubble cane on March 16, 1988.

One experiment consisted of testing the stubble digger in first stubble cane of varieties CP 70-321, CP 72-370 and CP 74-383. The data are reported in Table 10. The digger treatment reduced the cane yield of each variety mainly due to a reduction in millable stalk population.

A second experiment consisted of testing the stubble digger and rotary hoe in second stubble of varieties CP 70-321, CP 72-370, CP 72-370, CP 74-383 and CP 76-331. The data obtained are reported in Table 11. The stubble digger and hoe had a small effect on the cane yield of CP 70-321 and CP 72-370, but reduced the yield of CP 74-383 and CP 76-331. As an average of varieties, the cane yields with digger and hoe treatments were similar, but lower than that of the check plot.

A third experiment consisted of testing the stubble digger and rotary hoe in third stubble of varieties CP 65-357, CP 70-321 and CP 76-331. The data obtained in this test are reported in Table 12. The digger had a small effect on cane yield,

especially with CP 65-357 and CP 76-331. The rotary hoe reduced cane yields more than the digger with each variety. As an average of varieties, the cane yields on the check and digger plots were similar, but higher than the yield on the rotary hoe plots.

Stubble diggers have been used with some success by a limited number of growers in the past. The poor yield response obtained in the above preliminary tests is probably due to the relatively high plant population in the early spring of 1988. Also, the digger treatments were applied on March 16 which may not be the optimum date of application. More research is needed on time of application on different soil types.

Table 1. Effect of planting furrow width and rate of planting on plant cane yield of two varieties of sugarcane on a Commerce soil at the St. Gabriel Research Station, 1988.

Variety of cane	Drill width	Rate of planting	Plant cane yield	Stalk		Normal juice		Sugar yield
				No.	Wt.	Brix	Sucrose	
	in.	stalks	T/A	1000/A	lbs.	%	%	lbs/A
CP 70-321	V	2	41.7	32.1	3.20	17.2	14.7	8790
	15	2	45.7	35.3	2.90	17.2	14.5	9509
	15	4	48.5	38.4	2.69	17.5	14.8	10365
	24	2	46.9	36.0	3.18	17.4	14.8	9992
	24	4	48.2	40.1	2.61	17.7	15.1	10489
CP 74-383	V	2	39.4	34.2	2.50	16.6	13.6	7568
	15	2	44.8	39.9	2.68	16.4	13.4	8504
	15	4	44.7	40.6	2.47	16.4	13.5	8518
	24	2	40.4	35.2	2.70	16.5	13.7	7884
	24	4	44.4	40.0	2.49	16.7	13.9	8755
LSD .05			1.8	5.6	0.35	0.8	0.9	825

Rate of planting was the number of stalks planted in continuous lines with a 10% overlap.

Table 2. Effect of planting furrow width and rate of planting on first stubble cane yield of two varieties of sugarcane on a Commerce soil at the St. Gabriel Research Station, 1988.

Variety of cane	Drill width	Rate of planting	Stubble cane yield	Stalk		Normal juice		Sugar yield
				No.	Wt.	Brix	Sucrose	
	in.	stalks	T/A	1000/A	lbs.	%	%	lbs/A
CP 72-370	V	2	37.9	38.5	2.42	17.1	13.9	7512
	15	2	38.9	41.8	2.38	16.4	13.1	7160
	15	4	38.9	40.8	2.26	16.9	13.8	7645
	24	2	38.4	41.3	2.47	17.0	13.9	7561
	24	4	39.0	42.9	2.28	16.9	13.9	7691
CP 76-331	V	2	39.0	42.0	2.66	17.7	14.8	8284
	15	2	41.4	42.3	2.59	17.7	14.7	8776
	15	4	41.9	45.1	2.59	17.5	14.5	8740
	24	2	38.9	41.4	2.54	17.8	14.8	8269
	24	4	43.8	43.1	2.65	17.7	14.7	9234
LSD .05			2.8	5.1	0.39	0.8	0.7	761

Rate of planting was the number of stalks planted in continuous lines with a 10% overlap.

Table 3. Effect of date of planting on the plant cane yield of four varieties of sugarcane on Commerce soil at the St. Gabriel Research Station, 1988.

Variety of cane	Date of planting	Plant cane yield	Stalk		Normal juice		Sugar yield
			No.	Wt.	Brix	Sucrose	
	1987	T/A	1000/A	lbs.	%	%	lbs/A
CP 70-321	Sept. 4	35.6	35.9	2.86	17.3	14.7	7511
	Oct. 1	37.3	29.3	2.94	17.5	15.0	8050
	Nov. 2	33.3	31.2	2.84	17.3	14.7	6984
CP 72-370	Sept. 4	35.4	34.9	2.50	16.9	14.1	7097
	Oct. 1	33.3	31.2	2.55	15.9	13.1	6159
	Nov. 2	32.8	29.7	2.62	16.6	13.9	6474
CP 74-383	Sept. 4	33.6	35.5	2.26	16.4	13.7	6541
	Oct. 1	37.3	35.9	2.57	16.4	13.7	7253
	Nov. 2	36.1	33.8	2.47	16.2	13.5	6909
CP 76-331	Sept. 4	34.3	33.3	2.66	17.6	14.8	7323
	Oct. 1	38.5	32.1	2.99	17.5	14.9	8250
	Nov. 2	38.5	32.4	2.86	17.5	14.7	8102
LSD .05		2.6	4.3	0.37	0.7	0.7	683
			Mean planting date effect				
	Sept. 4	34.7	34.9	2.57	17.0	14.3	7118
	Oct. 1	36.6	32.1	2.76	16.8	14.2	7428
	Nov. 2	35.2	31.8	2.70	16.9	14.2	7117
LSD .05		1.3	2.2	0.18	NS	NS	NS

Table 4. Effect of date of planting on the first stubble yield of four varieties of sugarcane on Commerce soil at the St. Gabriel Research Station, 1988.

Variety of cane	Date of planting 1986	Stubble cane yield T/A	Stalk No. 1000/A	Stalk Wt. lbs.	Normal juice Brix %	Normal juice Sucrose %	Sugar yield lbs/A
CP 70-321	Sept. 2	31.0	34.3	2.28	18.2	15.5	6990
	Oct. 6	36.0	38.0	2.32	18.3	15.7	8205
	Nov. 1	35.0	30.5	2.51	17.9	15.3	7738
CP 72-370	Sept. 2	26.8	34.6	2.07	18.0	15.1	5859
	Oct. 6	32.6	37.4	2.03	17.6	14.8	6922
	Nov. 1	35.5	37.4	2.30	17.5	14.6	7457
CP 74-383	Sept. 2	33.8	35.4	2.11	17.8	15.1	7365
	Oct. 6	41.5	44.3	2.17	16.8	14.0	8282
	Nov. 1	38.7	43.2	2.16	17.3	14.4	7963
CP 76-331	Sept. 2	30.7	35.1	2.36	18.5	15.5	6910
	Oct. 6	38.5	40.3	2.30	18.5	15.6	8745
	Nov. 1	33.8	36.9	2.51	18.5	15.4	7545
LSD .05		2.0	6.1	0.31	0.7	1.1	579
			Mean planting date effect				
	Sept. 2	30.6	34.8	2.20	18.1	15.3	6781
	Oct. 6	37.2	40.0	2.21	17.8	15.0	8039
	Nov. 1	35.8	37.0	2.37	17.8	14.9	7676
LSD .05		1.0	3.1	0.16	NS	0.4	290

Table 5. Effect of date of harvest plant cane on the yield of the subsequent stubble cane of four varieties of sugarcane on Commerce soil at the St. Gabriel Research Station, 1988.

Variety of cane	Date of plant cane harvest 1987	Stubble cane yield T/A	Stalk No. 1000/A	Stalk Wt. lbs.	Normal juice Brix %	Normal juice Sucrose %	Sugar yield lbs/A
CP 70-321	Sept. 4	34.3	36.2	2.60	17.2	14.7	7249
	Oct. 1	32.6	31.1	2.24	17.0	14.2	6639
	Nov. 2	32.7	34.5	2.35	17.1	14.6	6846
	Dec. 1	34.2	34.2	2.38	17.3	14.5	7121
CP 72-370	Sept. 4	33.2	40.7	2.42	17.1	14.4	6824
	Oct. 1	29.7	29.4	2.03	16.5	13.6	5707
	Nov. 2	31.7	35.2	2.03	16.5	13.8	6215
	Dec. 1	32.1	36.4	2.32	17.2	14.5	6670
CP 74-383	Sept. 4	34.8	40.4	2.21	16.3	13.3	6528
	Oct. 1	35.8	36.7	2.11	16.7	13.9	7087
	Nov. 2	37.8	39.7	2.16	16.9	14.2	7683
	Dec. 1	39.6	42.6	2.21	16.8	13.8	7750
CP 76-331	Sept. 4	34.7	43.1	2.35	17.5	14.7	7316
	Oct. 1	32.9	35.8	2.22	17.6	14.7	6974
	Nov. 2	37.1	39.1	2.31	17.7	15.1	8070
	Dec. 1	37.5	38.5	2.45	17.6	14.8	8003
LSD .05		2.3	3.8	0.32	0.2	0.8	693
			Mean harvest date effect				
	Sept. 4	34.2	40.1	2.40	17.0	14.3	6979
	Oct. 1	32.7	33.3	2.15	16.9	14.1	6602
	Nov. 2	34.8	37.1	2.21	17.1	14.4	7204
	Dec. 1	35.9	37.9	2.34	17.2	14.4	7386
LSD .05		1.2	1.9	0.16	NS	NS	347

The plant cane of each variety was harvested on four dates in 1987 and the yield of the following first stubble cane was measured in November of 1988.

Table 6. Effect of date of harvest on the yield of four varieties of plant cane on Commerce soil at the St. Gabriel Research Station, 1988.

Variety of cane	Date of plant cane harvest 1988	Plant cane yield T/A	Stalk wt. lbs.	Normal juice Brix %	Normal juice Sucrose %	Sugar yield lbs/A
CP 70-321	Oct. 3	25.1	2.16	15.9	12.4	4320
	Nov. 1	36.8	2.80	16.8	14.1	7398
	Dec. 1	34.5	2.76	17.7	15.1	7511
CP 72-370	Oct. 3	26.1	2.13	15.4	12.0	4339
	Nov. 1	32.2	2.37	16.4	13.7	6237
	Dec. 1	33.1	2.57	17.3	14.2	6735
CP 74-383	Oct. 3	29.6	1.99	15.9	12.3	5042
	Nov. 1	36.8	2.50	16.2	13.4	6983
	Dec. 1	37.4	2.52	17.1	14.5	7802
CP 76-331	Oct. 3	31.3	2.19	16.2	12.6	5473
	Nov. 1	36.8	2.77	17.1	14.2	7465
	Dec. 1	35.7	2.75	18.5	15.8	8213
LSD .05		1.9	0.22	0.9	0.9	528
			Mean harvest date effect			
	Oct. 3	28.0	2.12	15.9	12.3	4793
	Nov. 1	35.7	2.61	16.6	13.9	7021
	Dec. 1	35.2	2.65	17.7	14.9	7565
LSD .05		1.5	0.11	0.4	0.4	264

The plant cane of each variety was harvested on four dates and the yields were measured on the last three harvest dates.

Table 7. Effect of stubble protection after three harvest dates of two cane varieties on the yield of the subsequent stubble crop at the St. Gabriel Research Station, 1988.

Date of plant cane harvest 1987	Stubble protection treatment	Stubble yield 1988	Stalk		Normal juice		Sugar yield
			No.	Wt.	Brix	Sucrose	
		T/A	1000/A	lbs.	%	%	lbs/A
			CP 65-357				
Oct. 1	Check	23.2	26.4	2.11	16.8	13.6	4485
	Cover	22.3	27.7	2.11	17.0	14.0	4433
Nov. 1	Check	26.9	29.0	2.15	16.9	13.8	5255
	Cover	26.0	27.3	2.16	17.1	14.3	5313
Dec. 1	Check	30.8	31.9	2.19	17.6	14.6	6472
	Cover	31.3	28.4	2.43	17.5	14.5	6526
			CP 72-370				
Oct. 1	Check	26.5	25.6	2.05	17.5	14.5	5507
	Cover	23.8	29.2	2.14	16.9	13.8	4685
Nov. 1	Check	25.7	27.9	2.11	16.7	13.6	5276
	Cover	24.0	26.7	2.06	16.7	13.8	4685
Dec. 1	Check	30.7	32.4	2.24	17.0	14.1	6194
	Cover	31.5	26.9	2.46	17.0	14.1	6335
LSD .05		2.3	4.3	0.20	0.7	0.6	510

The cane stubble was protected from freeze damage by covering it with soil immediately after each harvest date in 1987. The soil cover was removed in early spring and the stubble crop was harvested in November, 1988.

Table 8. Effect of varieties, Furadan and stubble protection on the yield of third stubble cane on a Commerce silt loam soil at the St. Gabriel Research Station, 1988.

Variety of cane	Stubble protection treatment	Cane yield	Stalk		Normal juice		Sugar yield
			No.	Wt.	Brix	Sucrose	
		T/A	1000/A	lbs.	%	%	lbs/A
			No Furadan Check				
CP 70-321	Check	28.4	32.3	2.17	16.0	12.7	5033
	Cover	25.7	28.5	2.16	16.6	13.1	4775
CP 72-370	Check	27.6	35.2	2.03	16.5	13.3	5199
	Cover	24.4	31.8	1.93	15.7	12.3	4178
CP 74-383	Check	30.0	42.3	1.75	16.1	13.2	5580
	Cover	27.8	33.6	1.72	15.9	12.4	4794
No Furadan Mean		27.3	33.9	1.96	16.1	12.8	4927
			Furadan - 10 lbs/A				
CP 70-321	Check	29.1	32.2	2.36	16.2	12.9	5274
	Cover	26.7	30.6	2.18	15.9	12.6	4683
CP 72-370	Check	31.2	36.8	2.11	16.3	13.4	5906
	Cover	27.3	36.3	1.90	16.0	12.8	4874
CP 74-383	Check	34.7	41.2	1.94	16.6	13.6	6686
	Cover	29.6	40.4	1.95	16.1	12.6	5225
Furadan Mean		29.8	36.2	2.07	16.2	13.0	5441
LSD .05 Treatment		2.4	4.4	0.24	0.9	1.2	861
LSD .05 Furadan		1.0	1.8	0.10	NS	NS	352
			Mean cover effect				
	Check	30.2	36.6	2.06	16.3	13.2	5613
	Cover	26.9	33.5	1.97	16.0	12.6	4755
LSD .05 Cover		1.0	1.8	NS	NS	0.5	352

Stubble protection consisted of covering the cane stubble after harvesting the second stubble crop in 1987 and removing the cover in the early spring of 1988.

Table 9. Effect of varieties, Furadan and stubble protection on the yield of first stubble cane on a Commerce silt loam soil at the St. Gabriel Research Station, 1988.

Variety of cane	Stubble protection treatment	Cane yield	Stalk		Normal juice		Sugar yield
			No.	Wt.	Brix	Sucrose	
		T/A	1000/A	lbs.	%	%	lbs/A
			No Furadan Check				
CP 65-357	Check	29.6	36.4	2.37	17.1	14.1	5976
	Cover	31.6	34.6	2.42	16.5	13.6	6097
CP 76-331	Check	32.5	36.9	2.69	17.5	14.7	6861
	Cover	33.0	36.4	2.72	17.4	14.5	6841
No Furadan Mean		31.7	36.1	2.55	17.1	14.2	6444
			Furadan - 10 lbs/A				
CP 65-357	Check	34.4	36.7	2.31	17.5	14.5	7143
	Cover	38.0	37.0	2.29	16.7	13.8	7437
CP 76-331	Check	34.6	41.8	2.59	17.7	14.8	7366
	Cover	37.0	37.4	2.73	17.0	14.1	7447
Furadan Mean		36.0	38.2	2.48	17.2	14.3	7348
LSD .05 All Treat.		1.7	3.5	0.36	0.7	0.7	534
LSD .05 Furadan		0.9	1.8	NS	NS	NS	267
			Mean cover effect				
	Check	32.8	38.0	2.49	17.4	14.5	6837
	Cover	34.9	36.3	2.54	16.9	14.0	6955
LSD .05 Cover		0.9	NS	NS	0.3	0.3	NS

Table 10. Effect of a stubble digger on first stubble yield of three varieties of sugarcane on a Commerce silt loam soil at the St. Gabriel Research Station, 1988.

Cane variety	Digger treatment	Cane yield	Stalk No.	Stalk Wt.	Normal juice Brix	Normal juice Sucrose	Sugar yield
		T/A	1000/A	lbs.	%	%	lbs/A
CP 70-321	Check	38.7	34.9	2.63	16.5	13.6	7475
	Digger	31.5	30.9	2.62	16.5	13.6	6090
CP 72-370	Check	38.1	34.6	2.64	15.6	12.3	6472
	Digger	32.9	31.6	2.34	15.1	11.7	5272
CP 74-383	Check	37.3	33.7	2.63	15.1	12.0	6146
	Digger	36.4	29.2	2.52	14.5	11.4	5672
LSD .05	Treat.	1.8	2.6	0.18	0.5	0.6	586
			Mean Digger Effect				
	Check	38.0	34.4	2.63	15.7	12.6	6698
	Digger	33.6	30.6	2.49	15.4	12.3	5678
LSD .05	Means	1.1	1.5	0.10	0.3	0.3	338

A stubble digger was operated in the cane stubbles of the treated plots on March 16, 1988.

Table 11. Effect of a stubble digger and rotary hoe on the second stubble yield of four varieties of sugarcane on a Commerce silt loam soil at the St. Gabriel Research Station, 1988.

Cane variety	Digger hoe treatment	Cane yield	Stalk		Normal juice		Sugar yield
			No.	Wt.	Brix	Sucrose	
		T/A	1000/A	lbs.	%	%	lbs/A
CP 70-321	Check	29.0	33.0	2.10	17.5	14.5	6034
	Digger	28.9	35.7	2.26	17.5	14.6	6049
	Hoe	27.0	33.7	2.00	16.5	13.3	5061
CP 72-370	Check	22.3	30.3	1.85	16.3	13.0	4052
	Digger	23.1	32.4	1.83	16.5	13.0	4220
	Hoe	20.8	29.7	1.91	17.0	13.7	4062
CP 74-383	Check	33.7	41.6	1.79	16.8	13.8	6582
	Digger	27.7	35.3	1.86	16.7	13.5	5277
	Hoe	29.8	44.4	1.95	16.8	13.7	5785
CP 76-331	Check	32.6	41.8	2.10	17.4	14.1	6579
	Digger	28.3	34.4	2.19	17.0	13.6	5434
	Hoe	30.4	36.5	2.29	17.7	14.5	6336
LSD .05		2.2	7.2	0.21	0.8	1.0	519
		Mean Digger and Hoe Effect					
	Check	29.4	36.7	1.96	17.0	13.8	5812
	Digger	27.0	34.4	2.04	16.9	13.7	5245
	Hoe	27.0	36.1	2.04	17.0	13.8	5311
LSD .05	Means	1.1	NS	NS	NS	NS	260

A stubble digger and a rotary hoe were operated in the cane stubbles of the treated plots on March 16, 1988.

Table 12. Effect of a stubble digger and rotary hoe on the third stubble yield of three varieties of sugarcane on a Commerce silt loam soil at the St. Gabriel Research Station, 1988.

Cane variety	Digger hoe treatment	Cane yield	Stalk		Normal juice		Sugar yield
			No.	Wt.	Brix	Sucrose	
		T/A	1000/A	lbs.	%	%	lbs/A
CP 65-357	Check	20.0	21.4	1.78	16.3	13.0	3656
	Digger	21.3	23.2	1.77	16.2	12.9	3837
	Hoe	18.7	22.5	1.67	16.0	12.7	3290
CP 70-321	Check	22.4	25.7	2.03	15.1	11.6	3149
	Digger	18.9	19.1	2.01	16.0	13.1	3467
	Hoe	17.3	17.4	2.08	16.1	12.8	3067
CP 76-331	Check	17.7	21.3	2.12	17.2	13.9	3475
	Digger	17.3	26.4	2.02	16.3	13.2	3196
	Hoe	15.4	14.2	1.88	17.2	14.1	3095
LSD .05		4.6	6.2	0.29	1.0	1.3	NS
			Mean Digger and Hoe Effect				
	Check	20.5	23.1	1.95	16.0	12.6	3417
	Digger	19.5	22.2	1.91	16.1	13.0	3561
	Hoe	17.5	18.8	1.88	16.3	13.0	3162
LSD .05	Means	2.9	3.9	NS	NS	NS	NS

A stubble digger and a rotary hoe were operated in the cane stubbles of the treated plots on March 16, 1988.

Sweet Sorghum for Biomass and Sugar Production in Louisiana

Ray Ricaud and Allen Arceneaux
Agronomy Department

An experiment was conducted in 1988 to determine the potential of growing sweet sorghum as a biomass and sugar fermentation feedstock for the production of fuel alcohol. The experiment consisted of a variety x fertilizer rate test on a Commerce silt loam soil on the St. Gabriel Research Station.

The varieties planted in the test were Wray, M81E and Cowley. The fertilizer treatments were 0-0-0, 90-0-0, 180-0-0, 180-0-80 and 180-0-160 in pounds/A of N, P_2O_5 and K_2O. The sorghum plots were planted in April and each variety was harvested at its mature stage during August and September. The plots were planted in two drills, 22 inches apart on rows spaced six feet apart. The plant spacing was three plants per foot in each drill. The plots were three rows wide and 50 feet long with three replications of each treatment. This method of planting was chosen to accommodate sugarcane harvesting equipment. The fertilizer treatments were bedded in the rows prior to planting. Atrazine was used as a preemergence herbicide and Guthion was used to control sugarcane borers. Furadan was applied at planting time to control lesser corn borers.

The plant population and yield of stalks, leaves and tops were measured at harvest time of each variety. Also, the percent brix or total sugar solids and sucrose in the sorghum juice and percent fiber in the stalks were measured at harvest time. The brix and sucrose were determined with a refractometer and polariscope, respectively. The total fermentable sugars were calculated from a predetermined relationship between liquid chromatograph analyses for total sugars and brix analyses expressed by the equation % total sugars = % Brix - .70. The alcohol yield was calculated from the theoretical conversion of .07 gallon of alcohol per pound of fermentable sugar.

Biomass Yield

The data obtained on biomass yield are reported for individual treatments in Table 1 and for factorial mean effect in Table 2. Although the plant population was the same for each variety in early spring, the average stalk population and weight at harvest time was less with Cowley than the other varieties. Apparently, less stooling occurred in the Cowley variety during the growing season. There was an increasing trend in stalk population and weight with increasing fertilizer rates in each variety. As an average of varieties, the 0-0-0 and 90-0-0 rates produced less stalk population and the 0-0-0 produced less stalk weight than the other fertilizer rates.

The percent fiber in the stalks which indicates percent juice extraction ranged from 12.4% in Wray to 15.9% in Cowley and was not affected by the fertilizer treatments. The net stalk yield per acre without leaves and tops was significantly higher in Wray (21.3 T/A) and M81E (21.8 T/A) than in Cowley (18.5 T/A). The stalk yield was increased with 90 lbs/A of N and with 180 lbs/A of N over the lower rate.

The percent leaves which were mostly still green at harvest time was higher in Cowley (20.3%) than in Wray (14.5%) and M81E (14.9%). The percent tops which included the seed heads was higher in M81E (4.4%) and lower in Wray (2.0%) than in Cowley. Cowley was lower in percent stalks and higher in percent leaves than the other varieties. The N fertilizer treatments increased the stalk yield per acre and decreased the percent tops in the total biomass.

The total biomass yield which included the stalks, leaves and tops was higher in M81E (27.1 T/A) than in Cowley (24.4 T/A). Wray and M81E were similar in biomass yield. The biomass yield was increased with N applications of 90 lbs/A and of 180 lbs/A over the lower rate.

The available soil K was relatively low, but the application of 80 and 160 lbs/A of potash did not significantly affect the yield of each biomass yield component.

Sugar and Alcohol Yield

The sugar and alcohol yield data are reported for each treatment and the factorial means in Table 3. The brix, sucrose and total sugars in the sorghum juice are expressed as percent of stalk weight and not as percent of extracted juice. The percent brix, sucrose and total sugars were highest in Wray, intermediate in Cowley and lowest in M81E. The differences in sugar content were much smaller between Wray and Cowley than between Cowley and M81E especially in percent sucrose. Wray and Cowley are early maturing sugar varieties and M81E is a late maturing sirup variety. However, due to the higher stalk yield with M81E, the total sugar and alcohol yields per acre were similar with Cowley and M81E, but lower than with Wray.

Each fertilizer treatment applied produced significantly more percent brix, sucrose and total sugar than the check plot. The sucrose, total sugar and alcohol yields per acre were increased with N application of 90 lbs/A and with 180 lbs/A over the lower N rate. The 80 and 160 lbs/A rates of potash did not increase the yield of the sugar components.

Table 1. Effect of varieties and rates of fertilizer on the biomass yield of sweet sorghum at maturity on a Commerce silt loam soil on the St. Gabriel Research Station, 1988.

Sweet Sorghum Variety	Fertilizer $N-P_2O_5-K_2O$ lbs/A	Stalk No. 1000/A	Stalk Wt. lbs	Stalk fiber %	Stalk fiber T/A	Stalk yield %	Stalk yield T/A	Leaves yield %	Leaves yield T/A	Tops yield %	Tops yield T/A	Total yield T/A
Wray	0-0-0	36.2	0.71	11.6	1.2	80.7	10.1	17.1	2.1	2.2	0.3	12.5
	90-0-0	40.5	1.23	12.9	2.6	84.5	20.5	13.4	3.3	2.1	0.5	24.2
	180-0-0	43.9	1.50	12.3	3.1	84.1	25.1	14.2	4.3	1.7	0.5	29.9
	180-0-80	41.4	1.41	12.7	3.1	83.1	24.3	14.7	4.3	2.2	0.6	29.3
	180-0-160	43.1	1.45	12.5	3.4	85.0	26.6	13.2	4.1	1.8	0.6	31.3
M81E	0-0-0	35.0	0.79	15.9	1.7	79.5	10.3	14.8	1.9	5.6	0.7	12.9
	90-0-0	38.5	1.18	14.3	3.0	83.7	20.9	12.0	3.0	4.3	1.1	24.9
	180-0-0	42.9	1.55	14.5	3.8	81.5	26.4	14.3	4.7	4.2	1.4	32.4
	180-0-80	43.2	1.36	15.1	3.8	78.9	25.9	16.3	5.4	4.8	1.6	32.3
	180-0-160	43.7	1.53	14.0	3.6	79.7	25.9	17.0	5.5	3.3	1.1	32.4
Cowley	0-0-0	31.4	0.65	15.6	1.2	77.4	7.7	16.7	1.6	6.0	0.6	9.9
	90-0-0	30.8	1.39	16.3	3.1	78.3	19.1	18.1	4.4	3.6	0.9	24.5
	180-0-0	42.1	1.13	15.8	3.4	72.9	21.9	24.1	7.2	3.0	0.9	30.0
	180-0-80	41.4	1.23	16.2	3.5	75.4	21.6	21.7	6.2	2.8	0.8	28.7
	180-0-160	41.5	1.25	15.5	3.4	76.6	22.2	20.9	6.1	2.5	0.7	29.0
HSD .05		8.4	0.41	2.0	0.8	4.6	4.8	4.8	1.7	1.7	0.5	6.2

Table 2. Mean effect of varieties and fertilizers on the biomass yield of sweet sorghum on Commerce silt loam soil, 1988.

Sweet Sorghum Variety	Fertilizer $N-P_2O_5-K_2O$ lbs/A	Stalk No. 1000/A	Stalk Wt. lbs	Stalk fiber %	Stalk fiber T/A	Stalk yield %	Stalk yield T/A	Leaves yield %	Leaves yield T/A	Tops yield %	Tops yield T/A	Total yield T/A
Wray		41.0	1.26	12.4	2.7	83.5	21.3	14.5	3.6	2.0	0.5	25.4
M81E		40.6	1.28	14.7	3.2	80.7	21.8	14.9	4.1	4.4	1.2	27.1
Cowley		37.5	1.13	15.9	2.9	76.1	18.5	20.3	5.1	3.6	0.8	24.4
	0-0-0	34.2	0.72	14.4	1.3	79.2	9.4	16.5	1.9	4.6	0.5	11.8
	90-0-0	36.6	1.27	14.5	2.9	82.2	20.2	14.5	3.6	3.3	0.8	24.5
	180-0-0	43.0	1.39	14.2	3.5	79.5	24.5	17.6	5.4	2.9	0.9	30.7
	180-0-80	42.0	1.34	14.6	3.5	79.2	23.9	17.6	5.3	3.3	1.0	30.2
	180-0-160	42.8	1.41	14.0	3.5	80.4	24.9	17.1	5.2	2.5	0.8	30.9
HSD .05	Variety	2.5	0.12	0.6	0.2	1.4	1.4	1.4	0.5	0.5	0.2	1.8
HSD .05	Fertilizer	3.8	0.19	NS	0.3	2.1	2.2	2.1	0.8	0.8	0.2	2.8

Table 3. Effect of varieties and rates of fertilizer on the sugar and alcohol yield of sweet sorghum on a Commerce silt loam soil on the St. Gabriel Research Station, 1988.

Sweet	Fertilizer	Sugar yield in stalks at maturity					Alcohol
Sorghum	$N-P_2O_5-K_2O$	Brix	Sucrose		Total sugars		yield
Variety	lbs/A	%	%	lbs/A	%	lbs/A	gal/A
Wray	0-0-0	16.0	12.9	2618	15.4	3109	218
	90-0-0	17.2	14.5	5941	16.6	6774	474
	180-0-0	17.9	15.1	7574	17.2	8633	604
	180-0-80	17.8	15.3	7431	17.2	8350	584
	180-0-160	17.8	15.2	8050	17.2	9126	639
M81E	0-0-0	12.2	8.2	1688	11.7	2405	168
	90-0-0	14.7	10.7	4467	14.2	5918	417
	180-0-0	13.6	9.2	4850	13.1	6903	483
	180-0-80	14.4	10.8	5618	13.9	7189	503
	180-0-160	13.3	8.9	4618	12.8	6616	463
Cowley	0-0-0	14.2	10.4	1602	13.7	2097	147
	90-0-0	17.4	14.4	5519	16.8	6419	449
	180-0-0	17.2	14.2	6196	16.6	7266	509
	180-0-80	17.2	14.2	6134	16.6	7166	501
	180-0-160	17.0	13.9	6191	16.4	7285	510
HSD .05		1.4	1.6	1258	1.3	1500	104
			Factorial mean effect				
Wray		17.3	14.6	6323	16.7	7198	504
M81E		13.6	9.6	4248	13.1	5806	407
Cowley		16.6	13.4	5129	16.0	6047	423
	0-0-0	14.1	10.5	1969	13.6	2537	178
	90-0-0	16.4	13.2	5309	15.9	6370	447
	180-0-0	16.2	12.8	6207	15.6	7600	532
	180-0-80	16.5	13.4	6395	15.9	7568	530
	180-0-160	16.0	12.7	6286	15.5	7676	537
HSD .05	Variety	0.4	0.5	371	0.4	442	31
HSD .05	Fertilizer	0.6	0.7	564	0.6	672	46

Sugar content expressed as percent of stalk weight.

USE OF PLANT ANALYSES IN EVALUATING THE NITROGEN, PHOSPHORUS AND POTASSIUM STATUS OF PLANT CANE

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In the fall of 1986, a sugarcane nitrogen x phosphorus x potassium soil fertility study was initiated at the Iberia Research Station on a Baldwin silty clay loam. Fertilizer treatments consisted of 80 and 160 lbs N/ac, 0 and 60 lbs P_2O_5/ac, and 0, 80, and 160 lbs K_2O/ac in all possible combinations. Each treatment was replicated three times. Plots were planted to variety CP 70-321 and treatments were applied in April, 1987. Plant leaf samples (leaf with the first visible dewlap) were taken on July 31 and analyzed for nitrogen, phosphorus, potassium, calcium, magnesium, copper, manganese, zinc, iron, and sulfur. Sugar yield and plant nutrient concentrations are given in Table 1.

Results show that T# 6 had a yield response to nitrogen application, T#'s 3, 8, and 9 responded to phosphorus application, and T# 11 responded to potassium application. Remaining treatments were not affected ($P>0.10$) by fertilizer treatments.

Plant analyses data show that 1.32% nitrogen was the plant concentration at which T# 6 responded to nitrogen application; phosphorus concentrations of 0.206, 0.182, and 0.185% for T#'s 3, 8, and 9, respectively, were found where sugarcane responded to phosphorus application; and 1.29% was the potassium concentration at which T# 11 responded to potassium application.

Although yield responses were not obtained with nitrogen application to T#'s 2, 3, and 4, their plant nitrogen concentrations were lower than that for T# 6 where a yield response was obtained. Treatments 8 and 9 also had lower plant nitrogen concentrations than T# 6. With phosphorus, T#'s 7, 11, and 12 all had plant phosphorus levels either equal to or smaller than that for T# 3 where a yield response was obtained with phosphorus application. With potassium T#'s 7 and 10 did not respond to potassium application and had lower plant potassium levels than T# 11 where a yield response was obtained with potassium.

The above demonstrates that nutrient concentrations did not do a good job of indicating whether or not a nutrient was deficient. Experience with other crops indicates that interpreting plant analyses based on nutrient balance (plant nutrient ratios) results in better diagnostic results. This approach will be examined in future work.

TABLE 1. EFFECT OF FERTILIZER APPLICATION ON SUGAR YIELD AND LEAF NUTRIENT CONCENTRATIONS ON A BALDWIN SILTY CLAY LOAM SOIL AT THE IBERIA RESEARCH STATION, 1987.

Treatment #	Fertilizer Applied $N-P_2O_5-K_2O$	Sugar[1] Yield	N	P	K	Ca	Mg	Cu	Mn	Zn	Fe	S
	lbs/ac	lbs/ac	- - - - - - - - - - % - - - - - - - - - -					- - - ppm - - - -				%
1	80-0-0	9,125	1.40	0.246	1.33	0.544	0.274	<5	63	13	58	0.191
2	80-0-80	9,338	1.31	0.260	1.59	0.553	0.269	<5	82	13	62	0.164
3	80-0-160	8,867	1.30	0.206	1.23	0.663	0.295	<5	100	12	65	0.166
4	80-60-0	9,360	1.30	0.255	1.34	0.511	0.237	<5	79	12	54	0.163
5	80-60-80	9,990	1.33	0.228	1.33	0.550	0.241	<5	89	13	77	0.143
6	80-60-160	9,763	1.32	0.210	1.47	0.498	0.256	6	78	12	58	0.154
7	160-0-0	9,430	1.41	0.206	1.22	0.599	0.260	5	83	14	62	0.160
8	160-0-80	8,976	1.28	0.182	1.45	0.473	0.247	<5	82	11	57	0.125
9	160-0-160	9,153	1.29	0.185	1.55	0.438	0.210	6	104	12	57	0.130
10	160-60-0	9,832	1.36	0.209	1.28	0.514	0.240	5	82	12	55	0.134
11	160-60-80	9,871	1.39	0.202	1.29	0.600	0.227	5	99	11	61	0.120
12	160-60-160	10,650	1.39	0.187	1.43	0.582	0.236	5	108	12	79	0.142
LSD (0.10)		708										

[1]Extractable soil K, Ca, Mg, and P were 227, 2996, 698, and 181 ppm, respectively. Soil organic matter was 1.52% and soil pH was 6.0. Experimental variety was CP 70-321. The cane was fertilized in April and harvested in December, 1987. Plant leaves at the first visible dewlap were taken at the end of July. Treatments with underlined nutrient concentrations had significant ($P<0.10$) yield responses with application of the indicated nutrient.

SOIL AND WATER MANAGEMENT

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Field Experiments:

A subsurface drainage experiment was conducted at the Graugnard farm in St. James Parish in 1988 to evaluate the response of sugarcane to drainage. In the past, subsurface drainage usually increased cane and sugar yields but in 1988, yields from subsurface drained and nondrained areas were about the same (Table 1).

A water table management experiment was conducted at the Westfield farm in Assumption Parish in 1988. In the water managed area, the water table was maintained between 2.8 to 3.0 feet below the soil surface during the cane's growing season, whereas in the check area, the water table was allowed to fluctuate. Cane yields from water managed and check areas were about the same (Table 2). Sugar yield from the check area was slightly higher than that in the water table managed area (Table 2). Annual rainfall in 1988 at both Graugnard's and Westfield's was approximately four inches above normal, however, the water table did not remain in the cane's root zone very long.

Table 1. Summary of the 1988 sugarcane data from the subsurface drainage experiment on the Graugnard farm, St. James Parish, Louisiana.

	Subsurface Drained	Nondrained
Sugarcane yield (tons/acre)	30.57	30.79
Sugar yield (lbs/ton, CRS)	204.17	201.80
Sugar yield (lbs/acre, CRS)	6237.00	6214.00
Plant population (stalks/acre)	28048.00	26435.00
Stalk weight (lbs/stalk)	2.18	2.34
Cane left in the field (T/A)	1.60	1.29

1/ Contribution from the Soil and Water Research Unit, USDA-ARS, Baton Rouge, Louisiana in cooperation with the Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, Baton Rouge.

2/ Agricultural Engineers, USDA-ARS, Soil and Water Research Unit, Baton Rouge, Louisiana.

Table 2. Summary of 1988 sugarcane data from the water management experiment on the Westfield farm, Assumption Parish, Louisiana.

	Water Managed	Check
Sugarcane yield (tons/acre)	36.34	36.60
Sugar yield (lbs/ton, CRS)	208.00	218.90
Sugar yield (lbs/acre, CRS)	7557.00	8009.00
Plant population (stalks/acre)	33815.00	33958.00
Stalk weight (lbs/stalk)	2.16	2.16
Cane left in the field (T/A)	0.62	0.32

Consequently, excess soil water in the soil profile was not a serious problem. The state average sugar yield was near a record level indicating that weather conditions were favorable for sugar production in Louisiana in 1988.

Modeling:

The simulation model DRAINMOD was modified to predict the daily water table fluctuations midway between subdrainage/subirrigation conduits in an automatic sump-controlled water table management (WTM) system. Data from an automated WTM field experiment on a Commerce silt loam soil at Westfield was used to validate the model. Daily water table depth was predicted within an average deviation of 7 cm and standard error of $\pm$ 10 cm. These results will aid action agencies (SCS and Extension Service) and consulting engineers in selecting or designing the "best" method of sump-control or operation for specific soil, crop, and climate conditions. This research is continuing through the development of a more comprehensive simulation model based upon the finite-difference solution of the Boussinesq equation to predict the depth or fluctuation of the water table at 15 or more points between the drainline and the midpoint between drains. The improved prediction of changes in water table depth during WTM system control provides more accurate estimates of pumping requirements for subdrainage and subirrigation cycles and permits estimating crop yield at varying distances from drainlines. This enhanced model will serve as an "expert knowledge base" in a future Decision Support System being developed to help farmers manage or operate WTM systems to increase effectiveness and efficiency of water use, reduce required amounts of fertilizer and other chemicals applied, thereby maximizing profits and reducing the potential of polluting surface and groundwater supplies.

The effects of soil layering on hydraulic conductivity (K) values determined from vertical sinks (auger holes) compared to horizontal sinks (ditches and subsurface drains) were evaluated with a finite element model. Vertical and horizontal sinks give similar values of equivalent hydraulic conductivity for

uniform soils under steady flow conditions. In layered soils with large differences in conductivity between layers, equivalent conductivity values will depend upon the thickness and position of layers in the profile. With low conductivity layers on top, equivalent K values for vertical sinks are high. With high conductivity layers on top, equivalent K values for vertical sinks are low for shallow surface layers, but become high for deep surface layers and large differences in conductivity between layers.

A finite element numerical technique was used to study the effects of soil anisotropy on flow to drains in multilayered sloping soils. The results are important in the study of the movement of agricultural chemicals in soils. The presence of drains increased the total flow entering the surface of a hillside and often eliminated surface seepage outflow. For a given equivalent hydraulic conductivity ratio (K_1/K_2) in a two layered profile with only one layer anisotropic, the flow rate increased as the degree of anisotropy for the upper or lower layer increased (i.e., the horizontal conductivity component became dominant). The increase was most evident when the anisotropic layer was the most conductive layer.

Sugarcane Weed Control Research[1]

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Weeds continue to limit maximum sugarcane production. Where itchgrass is a problem, trifluralin (Treflan, Trilin, or Trifluralin) is a recommended treatment. Due to volatility and photodecomposition of the herbicide, a thorough mixing or incorporation on the sugarcane bed is imperative for consistent weed control. Generally, a shaving operation is needed to remove the old stubble and winter weeds to facilitate herbicide incorporation with a rolling cultivator. Due to the tendency of a heavy soil to be cloddy, thorough incorporation is more difficult than on a lighter soil. Heavier soils are slower to dry in the spring and producers are often forced to begin early land preparation, thereby encouraging cloddy, conditions. A "non-incorporable" alternative herbicide with itchgrass activity is needed. Such a herbicide could be applied on a band directly to the bed after off-barring and activated (moved into the soil) by rainfall.

Past research has shown that Command (clomazone), Reflex (fomesafen), and Prowl (pendimethalin)provide good preemergence control of itchgrass in soybeans. Research was conducted in 1988 at Rougon and Thibodaux, LA to compare itchgrass control in sugarcane with Treflan and Prowl incorporated following shaving to that of non-incorporated herbicides, Command, Reflex, cinmethylin (Cinch), and Prowl when applied to an undisturbed sugarcane bed. In late March, herbicides were applied when sugarcane was 25 inches tall at Rougon; new cane growth was not present at Thibodaux. Itchgrass control with Prowl, either surface applied or incorporated, at 2.0 lb/A (broadcast) was approximately 88% (Table 1). Reflex at 0.75 lb/A and Prowl provided at least 88% itchgrass control at both locations, comparable to that of the standard Treflan treatment. Command at 1.0 lb/A provided 95% itchgrass control at Rougon, but only 70% at Thibodaux. Poor itchgrass control was generally obtained with Cinch at both locations. Rainfall for activation was received within 10 days after herbicide application at both Rougon and Thibodaux. Sugarcane injury was minimal for all treatments. Some temporary bleaching or whitening of the cane was noted for the Command treatment at Rougon (where cane had emerged), but not at Thibodaux. Herbicides were also evaluated as layby treatments and itchgrass control was similar to that of Treflan.

Evik (ametryn), Ignite (glufosinate), and Gramoxone Super (paraquat) were applied post directed underneath the sugarcane canopy in July to evaluate control of 6-18 inch itchgrass. Excellent control was obtained with minimal cane injury. These herbicides offer possibility in salvage-type situations when itchgrass is too large for control with Asulox (asulam).

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[1]This research was supported in part by funds provided by the American Sugarcane League.

Several experimental postemergence herbicides from DuPont (DPX V9360), Ciba Geigy (CGA 136872), Kumiai (KIH 2665) chemical companies have shown promise for itchgrass, johnsongrass, and broadleaf weed control in corn, and were evaluated for sugarcane tolerance. Cane tolerance was somewhat variable and appeared related to method of application. Injury was less when herbicides were applied using a 2-nozzle arrangement could be used in situations when itchgrass is smaller than sugarcane, thereby minimizing contact with the sugarcane terminal. Rates of the postemergence herbicides will need to be refined to determine itchgrass and johnsongrass efficacy and sugarcane tolerance.

Table 1. Itchgrass control with preemergence incorporated (PI) and preemergence surface (PS) herbicide treatments. Thibodaux and Rougon, LA 1988.

Herbicides	Rate	Method of application	Itchgrass Control	
			Thibodaux	Rougon
	lbai/A		----------%----------	
Treflan	2.0	PI	88	98
Prowl	2.0	PI	88	89
	2.0	PS	88	89
	3.0	PS	80	88
Cinch	1.0	PS	50	68
	2.0	PS	66	91
Reflex	0.5	PS	84	93
	0.75	PS	88	93
Goal	1.0	PS	76	84
	2.0	PS	80	90
Command	1.0	PS	69	95
	1.5	PS	75	95
LSD (0.05)			20	14

Sugarcane Smut and Pythium Root Rot Research[1]

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Smut Resistance Studies:

Experimental sugarcane varieties were dip-inoculated with smut spores and planted in a replicated test. Based on smut infection levels observed during the 1988 growing season, 5 (9%), 14 (26%), and 35 (65%) of 54 1982 - 1985 series clones; 11 (28%), 4 (10%), and 25 (62%) of 40 1986 series clones; and 3 (5%), 8 (15%), and 43 (80%) of 54 1987 series clones were rated as highly susceptible, moderately susceptible, or resistant, respectively, to smut.

The results of a quantitative inheritance study, reported previously, indicated that resistance to smut was a moderately heritable trait in the Louisiana sugarcane breeding population and that clone smut reactions in an inoculated test were moderately repeatable. Smut reactions of experimental varieties in inoculation tests also were analyzed and found to be moderately repeatable. Repeatability estimates, on a scale of 0 to 1, were 0.56 and 0.36 for one test population between plant cane and first stubble and for two subsequent plant cane tests, respectively. Estimates were 0.32 and 0.46 for smut reaction repeatability from plant cane to first stubble and plant cane to plant cane, respectively, for a second experimental variety population. The smut reaction repeatability estimate for the population in two first stubble crops was 0.55. Smut reactions were moderately repeatable for resistant, moderately susceptible, and high susceptible experimental variety groups. These results indicate that environmental conditions exert a considerable influence on clone smut reactions under Louisiana conditions. Therefore, multiple annual inoculation tests are needed to accurately assess smut resistance in experimental varieties.

The rate of smut increase between plant cane and stubble crops for different varieties is an important aspect of resistance, particularly for moderately susceptible clones. However, attempts to assess this trait in plant cane and first stubble of inoculation tests were unsuccessful. Changes in clone smut reactions between plant cane and first stubble in different experiments were inconsistent and appeared to be affected by the level of smut infection resulting from inoculation in plant cane. In the future, only smut infection data from plant cane will be collected from inoculation tests, and a natural infection test will be initiated to attempt to evaluate and compare rates of disease increase in different varieties.

Studies on Smut Spore Production, Dispersal, and Viability:

The production of smut whips over time was monitored in smut inoculation tests. Whip production began during May, increased sharply during June and July, and continued during August, September, and October, particularly in susceptible clones. A portion of the whips produced late in the season typically developed from lateral shoots on lodged cane.

[1]This research was supported in part by grants from the American Sugar Cane League and the Louisiana Education Quality Support Fund.

Counts of smut spores collected from spore traps indicated that spore concentrations in the air increased during May and were high from June through September. Spore concentration per cubic meter of air decreased with distance, and concentrations typically were less than 0.5% of levels detected above the crop at a distance of 135 meters (450 feet).

Smut spore numbers deposited at the base of plants decreased sharply with increasing distance from an inoculum source. Heavy concentrations of spores were deposited at the bases of plants directly adjacent to a sugarcane stool containing smut whips. Spore deposition gradients became steeper and the numbers of spores deposited lower during the course of the growing season as plants grew up around the smut whips and the whips aged. This research was conducted in cooperation with Dr. Mike Grisham, Sugarcane Research Unit, Houma.

Viability of smut spores began to decrease after 2 weeks in sugarcane and nonsugarcane soils at different moisture levels. After 2 months, less than 1% of the spores were capable of germinating. These results suggest that smut spores produced during one season do not survive the winter and do not play a significant role in the disease the following season.

Pythium Root Rot Research:

Efforts to develop methods to selectively isolate Pythium arrhenomanes from sugarcane roots and soil were unsuccessful. Mycelial proteins of Pythium species were compared in polyacrylamide gel electrophoresis, and species could be separated by differences in protein banding patterns. Isolates within Pythium species showed minor variations in banding patterns or intensities. Pythium species were also separated by isozyme polymorphisms in starch gel electrophoresis. Some isolates of P. arrhenomanes and P. graminicola were found to be indistinguishable. The potential for identifying species-specific proteins and developing an assay for P. arrhenomanes is uncertain.

In greenhouse pathogenicity tests, only isolates of P. arrhenomanes caused significant reductions in sugarcane root and shoot growth. Additional isolates of P. spinosum were tested and found to be non-pathogenic. When plants were grown in soil infested with combinations of isolates of P. arrhenomanes, P. irregulare, and P. spinosum, the latter two Pythium species frequently isolated from sugarcane roots had no effect on the amount of root rot caused by P. arrhenomanes.

During 1988, field tests to determine if treatments with a fungicide, metalaxyl, will control Pythium root rot and increase sugarcane stubble yields were continued at the LSU St. Gabriel Experiment Station and on commercial farms. Significant yield increases were obtained from treated plots in two of four experiments at St. Gabriel. In an experiment containing treatments with and without ratoon stunting disease (RSD), metalaxyl treatments increased yields in RSD-infected and RSD-free plots but did not alleviate the stunting caused by RSD in CP 70-330. In commercial farm experiments, no metalaxyl treatments significantly increased plant cane (two experiments) or first stubble (two experiments) yields. Yields in some treatments were significantly less than the untreated control in two experiments. Research will be conducted to attempt to determine the causes of the erratic field test results.

SUGARCANE PATHOLOGY RESEARCH

K. E. Damann, Jr., R. A. Navarre, and E. Chiarulli
Department of Plant Pathology and Crop Physiology

RSD HARVESTER SPREAD TEST:

In the Fall of 1986 three cultivars of sugarcane, L 62-96(RSD susceptible), CP 65-357 KT(RSD intermediate), and L 60-25(RSD resistant) were planted at the St. Gabriel Experiment Station. Each stalk of seed ,except for the CP 65-357 KT (gift from CGI), was checked for RSD by centrifuging out vascular contents and looking for bacteria and by alkaline-induced metaxylem autofluorescence prior to planting and only disease-free stalks were used. In the Spring of 1987 RSD-infected plants were transplanted to the field so that each variety was preceeded by 1, 2, or 4 diseased stools. A lilloston cultivator was run through a row of diseased CP 70-321 just before passing through CP 65-357 KT. All these treatments were done in triplicate. The plot layout is shown in Figure 1. There was an empty row between each planted row.

		*	**		
Row 12	CP 65-357 KT	2	----------	1----------	4----------
Row 11	L 60-25	4		2	1
Row 10	CP 65-357 KT (LILLOSTON)	-		-	-
Row 9	L 60-25	1		4	2
Row 8	CP 65-357 KT (LILLOSTON)	-		-	-
Row 7	L 62-96	1		2	4
Row 6	L 62-96	1		2	4
Row 5	CP 65-357 KT	2		1	4
Row 4	CP 65-357 KT	-		-	-
Row 3	L 62-96	1		2	4
Row 2	L 60-25	2		1	4
Row 1	CP 65-357 KT	4		2	1

Figure 1. RSD SPREAD TEST PLOT PLAN
* Indicates the number of diseased stools preceeding clean cane.
** Indicates 50 feet of clean cane of the cultivar indicated.
Direction of harvest and lilloston cultivation is from left to right.

In the Fall of 1987 the plot was harvested by running the harvester down the row so it would cut diseased stools and then the clean cane (left to right in Figure 1.). Basal nodes from the cane cut and layed in the row from the 3 reps of each of the 3 cultivars preceeded by 4 diseased stools were collected, sequentially numbered from every foot down the row to 40 feet and planted in the greenhouse overwinter. These plants were transplanted to separate rows in the Spring of 1988 in the same sequence they were collected.

The plots were sampled for RSD spread during the Fall and Winter of 1988. This was done by cutting basal stalk pieces every foot down the row to a point 40 feet from the diseased source plant(s). The source plant stools were also sampled. The sample internodes were centrifuged to microscopically check for the bacteria and the same piece was checked for fluorescence. There was good agreement between the two methods. The results are summarized in Table 1.

Table 1. Spread of RSD by the sugarcane harvester as indicated by per cent of diseased stalks detected in the first 40 feet of originally clean cane.

CULTIVAR	# OF DISEASED STOOLS PRECEEDING PLOT 1	2	4
L 62-96 (SUSCEPTIBLE)	30	54	75
CP 65-357 (INTERMEDIATE)	10	11	10
L 60-25 (RESISTANT)	0	0	0

As expected the susceptibility of the cultivar has a great effect on the rate of spread as does the number of diseased stools preceeding the clean cane for L 62-96. This is probably a function of both the greater susceptibility (infectability) and the greater populations of bacteria produced in the susceptible cultivars available for spread.
Only 1 Of 100 stalks sampled from the first 40 feet of the 3 lilloston treated rows showed disease. The lilloston cultivator appeared relatively inefficient in spreading RSD compared to the harvester.
Results from the spread up the stalk for the 3 cultivars was 8, 5, and 0% of the stalks for L 62-96, CP 65-357 KT, and L 60-25, respectively. It appeared that spread down the row into the stubble was greater than spread up at the point of cutting the standing stalk. However it should be remembered the this represents spread to the top only at the basal cut. It is possible that sticker chains spread RSD farther up the stalk and this would not have been detected.

SMUT FUNGUS RESEARCH:

The smut fungi, Ustilago scitaminea on sugarcane (elongate whips) and Ustilago maydis on corn (galls), produce symptoms on infected plants which suggest involvement of plant hormones. We have found that each of these fungi is capable of producing the plant hormone indole acetic acid (IAA) in artificial culture. It is known that tryptophan is an IAA precursor and tryptophan amended media are required for IAA production in this system. Attempts to detect another class of plant hormones called cytokinins in culture filtrates have been negative. We will be trying a bioassay system to detect cytokinin activity.

The genomes of these two smut fungi have been sucessfully separated and karotyped by alternating field gel electrophoresis by Roy Navarre. DNA probes, from bacterial pathogens, for two genes for IAA synthesis and one gene for cytokinin synthesis will be used to probe the smut chromosome DNA to determine if similar genes exist there, and if so on which chromosome(s) they reside. Through this approach we will be able to begin to evaluate the role of plant hormones in these diseases.

SUGARCANE TISSUE CULTURE RESEARCH:

Ongoing work on sugarcane tissue culture with Dr. E. Chiarulli has resulted in ability to produce viable protoplasts of sugarcane cultivar CP 70-321. Development of techniques to evaluate viability of protoplasts has allowed us to make several approaches to optimizing conditions for recovering callus from protoplasts which is capable of regenerating plants. We have suscessfully differentiated plants from callus of sugarcane, but have not been sucessful in producing active viable callus from protoplasts. This latter goal of producing plants from protoplasts is one shared by many tissue culture workers in sugarcane but has yet to be reproducibly accomplished by anyone. Dr. Chiarulli has built an electrofusion apparatus which has allowed us to fuse protoplasts of sugarcane but the inability to grow out fused protoplasts to the plant stage prevents the possibility of forming some interesting hybrids of sugarcane cultivars or of sugarcane with other plant species.

Chemical Control of the Sugarcane Borer

T. E. Reagan and R. T. Bessin

Portion of Annual Report LAES Project LA2013

Fourteen insecticide treatments were applied in a 5 replication randomized block experiment of ratoon CP74-383 sugarcane at the St. Gabriel Research Station in plots of 3 rows on 1.8m centers x 7.4 m ca. 0.01 acres. Spray mixture was applied to the canopy using Solo knapsack sprayers with pressure and output approximately 14 psi and 260 liter/ha, respectively. In order to enhance nematode activity, Biosafe® was applied during light rain or in the evening before dew formed within 24 hours of other treatment applications. Javelin (Bacillus thuringiensis) granules were applied with a "shaker jar" (1 pint mason jar with 5 mm holes in top) over the canopy. When sugarcane borer larvae sampled randomly exceeded the 5% economic threshold of stalks with live larvae in leaf sheaths, applications were made (Aug. 15, 31, Sept. 19), the latter two treatments being made when infestation levels in plots treated with Guthion 2L 0.75 lb AI/acre exceeded the 5% threshold. Season-long control was evaluated on 24 October by examining 25 stalks randomly selected from the center of each plot for D. saccharalis entrance and exit holes.

As shown in the table, the mixture of Baythroid 2EC (0.016 lb AI/acre) plus Guthion 2L (0.45 lb AI/acre) provided 93% control. Baythroid 2EC (0.0125 lb AI/acre) plus Guthion 2L (0.33 lb AI/acre), Asana XL (0.03 lb AI/acre) plus Orthene 75SP (0.25 lb AI/acre), and Karate provided 87 to 89% control. All of the above treatments were significantly superior to the standard Guthion 2L. Asana XL, Guthion 3F, and Capture 2EC provided similar levels of control to the standard Guthion 2L. Javelin was significantly less effective than the standard Guthion 2L, but this control was significantly greater than the untreated check. Three applications of Biosafe resulted in significantly more bored joints than the untreated check. It is suggested that such increased borer damage may be due to suppression of beneficial arthropods such as the imported fire ant, Solenopsis invicta (Buren), the main predator of the sugarcane borer in Louisiana. All treatments except Biosafe and Javelin produced significantly less moth emergence from damaged internodes than the untreated checks.

Insecticidal control of the sugarcane borer at the St. Gabriel Sugarcane Research Station, 1988

Treatment and lb(AI)/Acre		% Internodes Bored	%SCB Control[a]	% Moth Emergence[b]	% Moth Reduction[c]
Biosafe	($1x10^7$)[d]	31.0a	-33.6	36.0a	- 8.4
Check		23.0a	----	33.2ab	----
Javelin 0.8 BIU[e]	5.60 BIU	18.0c	22.4	19.4bc	41.6
Javelin 0.8 BIU	8.00 BIU	17.2c	25.9	32.0ab	3.6
Guthion 2L	0.75	8.9d	61.6	8.8cd	73.5
Asana XL 0.66EC	0.033	5.6de	75.9	2.8d	91.6
Capture 2EC	0.03	5.5de	76.3	4.0cd	88.0
Asana XL 0.66EC	0.025				
+ Orthene 75SP	0.25	4.2de	81.9	7.2cd	78.3
Guthion 3F	0.75	3.4de	85.3	4.8cd	85.5
Baythroid 2EC	0.033	3.1e	86.6	4.2cd	87.3
Baythroid 2EC	0.0125				
+ Guthion 2L	0.33	2.8e	87.9	2.4d	92.8
Asana XL 0.66EC	0.03				
+ Orthene 75SP	0.25	2.7e	88.4	4.0cd	88.0
Karate 1EC	0.02	2.5e	89.2	4.0cd	88.0
Baythroid 2EC	0.016				
+ Guthion 2L	0.45	1.6e	93.1	5.0cd	34.9

Numbers not followed by same letter differ significantly (P = 0.05; DMRT).

[a]% internodes bored in treated plots compared to untreated plots.

[b]Proportion of SCB exit holes to bored internodes.

[c]% emergence in treated plots compared to untreated plots.

[d]*Steinernema feltiae*; $1x10^7$ nematodes/acre.

[e]Billion international units/lb.

Integration of Control Tactics for the Sugarcane Borer

T. E. Reagan, Ricardo Bessin, and E. B. Moser

Portion of Annual Report LAES Project LA2013

A three-year split-split-plot (4 replication) study conducted to evaluate the contributions of arthropod predation, sugarcane varietal resistance and insecticidal control toward the management of the sugarcane borer, Diatraea saccharalis (F.), helped to quantify the value of multiple pest management approaches. As shown in the table, insecticidal control was the predominant factor preventing plant injury by the borer, supplying more than 60% of the overall control. However, varietal resistance was almost as effective as insecticidal control at suppressing adult borer emergence, each contributing 42 and 47% control, respectively. Even a moderately resistant sugarcane variety, CP65-357, substantially reduced adult moth emergence. The contribution of varietal resistance of CP65-357 toward control of plant injury was diminished under high borer infestations. A significant interaction ($P < 0.05$) was detected between varietal resistance and insecticidal control due to the greater insecticidal control of adult emergence on the susceptible and moderately resistant varieties than on the resistant variety. Leafsheath appression, in reducing D. saccharalis larval establishment on the protected sugarcane internode, also seemed to limit the penetration of non-systemic insecticides to the larvae in the leafsheath. Despite this limited incompatibility, greater borer control was always obtained with the incorporation of additional management factors.

Relative contributions of arthropod predation, varietal resistance, and Pydrin® in controlling sugarcane borer injury and adult moth predation on sugarcane.

	Proportion of Control Based on % Bored Internodes			
Control Factor	1985	1986	1987	Average
Predation	12	14	18	14.7
Variety Resistance	16	26	27	23
Insecticide Treatment	72	60	55	62.3
	Proportion of Control of Adult Moths			
	1985	1986	1987	Average
Predation	10	10	12	10.5
Variety Resistance	50	43	28	40.5
Insecticide Treatment	40	47	60	49

Varietal Resistance to *Diatraea saccharalis*

T. E. Reagan and Ricardo Bessin

Portion of Annual Report LAES Project LA2657 and LA2013

Resistance to *D. saccharalis* damage in sugarcane can be categorized predominately as antibiosis. Physical characteristics of the plant, such as leaf-sheath appression and rapid rind hardness development contribute to the differential survival of the young larvae among cultivars. The use of percent bored internodes ranks sugarcane cultivars on observed external evidence of *D. saccharalis* tunneling into the stalk. However, the degree of internal damage to the plant and the ultimate survival of *D. saccharalis* larvae are not addressed with this index. Varietal resistance to the latter stages of the *D. saccharalis* life cycle have been investigated in this study. Although advancement of cultivars that are less likely to be damaged by *D. saccharalis* should be a primary goal of the breeding program, resistance that reduces overall pest populations should also be investigated.

The LCP86 series (23 cultivars) was planted in a four-replicated lattice design on the Lanaux Plantation, near Edgard, LA. Four commercial cultivars were included in this study, CP70-321, CP65-357, CP61-37, and CP74-383, which respectively corresponded to SCB resistant, moderately resistant, and two susceptible cultivars. At harvest, one-15 stalk sample was evaluated from each 10 foot plot for damage (% bored internodes) and relative survival in the stalk (ratio of exit holes to bored internodes).

SCB varietal resistance evaluations revealed that three cultivars exhibited less damage than that sustained by the resistant cultivar CP70-321, and 18 cultivars had lower levels of larvae surviving inside the stalk than the relative survival on CP70-321 (Table 1). Although CP70-321 resists penetration of *D. saccharalis* into the stalk, upon entry the larvae appear to survive better than in most of the other cultivars used in this study. Another commercial cultivar, CP74-383 (susceptible), ranked 23 out of 27 when using external damage as the ranking criteria. However, when relative survival is the criteria for ranking this cultivar it is ranked 12 relative to the other cultivars.

Thus, resistance rating based on external evidence of *D. saccharalis* entry into the stalk does not accurately represent the degree of resistance acting upon larvae in the stalk.

Relative to this insect pest in sugarcane, a grower's primary objective is to minimize economic impact. There are two approaches to reduce the economic impact of pests. The first is to minimize damage caused by the pest and the second approach is to minimize the overall cost incurred controlling the pest. Use of resistant sugarcane cultivars reduces pest damage at little or no cost to the grower. Current *D. saccharalis* resistance rating schemes are focused at the prevention of damage, whereas in this study an additional criteria is proposed. Incorporating the cultivars' pest survival rating allows for identification of cultivars which enhance *D. saccharalis* populations and involves little additional data collection; and enhances the efficiency and value of the entomological component in the sugarcane varietal breeding and development program.

Table 1. Diatraea saccharalis damage and relative survival inside the stalk in four commercial and 23 experimental cultivars (1986 LCP series) during 1988 on the Lannaux Plantation, near Edgard, LA.

Cultivar	% Bored Internodes[1/]	Relative Survival[2/]	Rank Based on % Bored Internodes	Rank Based on Relative Survival
LCP86-468	57.64 a	19.59 abcd	27	20
LCP86-451	53.87 ab	26.99 a	26	27
LCP86-393	50.79 abc	16.23 abcdef	25	13
LCP86-435	47.38 abcd	21.05 abcd	24	22
CP74-383	44.35 abcde	16.14 abcdef	23	12
LCP86-438	43.48 abcde	14.63 bcdef	22	7
LCP86-434	43.21 abcdef	20.21 abcd	21	21
CP61-37	43.20 abcdef	23.38 abc	20	23
LCP86-450	42.67 abcdefg	15.15 cdef	19	6
LCP86-408	42.00 abcdefgh	15.83 bcdef	18	10
LCP86-457	41.72 abcdefgh	23.90 abc	17	24
LCP86-412	39.75 bcdefgh	19.33 abcd	16	19
LCP86-458	39.56 bcdefghi	9.95 f	15	1
CP65-357	36.80 cdefghij	17.13 abcdef	14	14
LCP86-447	35.20 cdefghijk	15.36 bcdef	13	11
LCP86-414	32.54 defghijkl	18.53 abcde	12	17
LCP86-453	31.63 efghijkl	18.34 abcde	11	16
LCP86-429	28.94 efghijkl	24.09 abc	10	25
LCP86-463	28.42 fghijkl	17.22 abcdef	9	15
LCP86-411	28.29 fghijkl	15.13 bcdef	8	8
LCP86-402	27.44 ghijkl	25.47 ab	7	26
LCP86-420	26.74 hijkl	12.32 def	6	4
LCP86-395	24.69 ijklm	14.70 cdef	5	5
CP70-321	24.46 jklm	19.25 abcd	4	18
LCP86-419	22.75 klm	15.07 bcdef	3	9
LCP86-454	21.86 lm	11.22 ef	2	2
LCP86-426	14.83 m	12.51 def	1	3

1/ Means within the same column followed by the same letter are not significantly different, DMRT $P<0.05$.

2/ Based on a ratio of D. saccharalis exit holes to bored internodes.

Sugarcane Borer Fecundity

Ricardo T. Bessin and T. E. Reagan

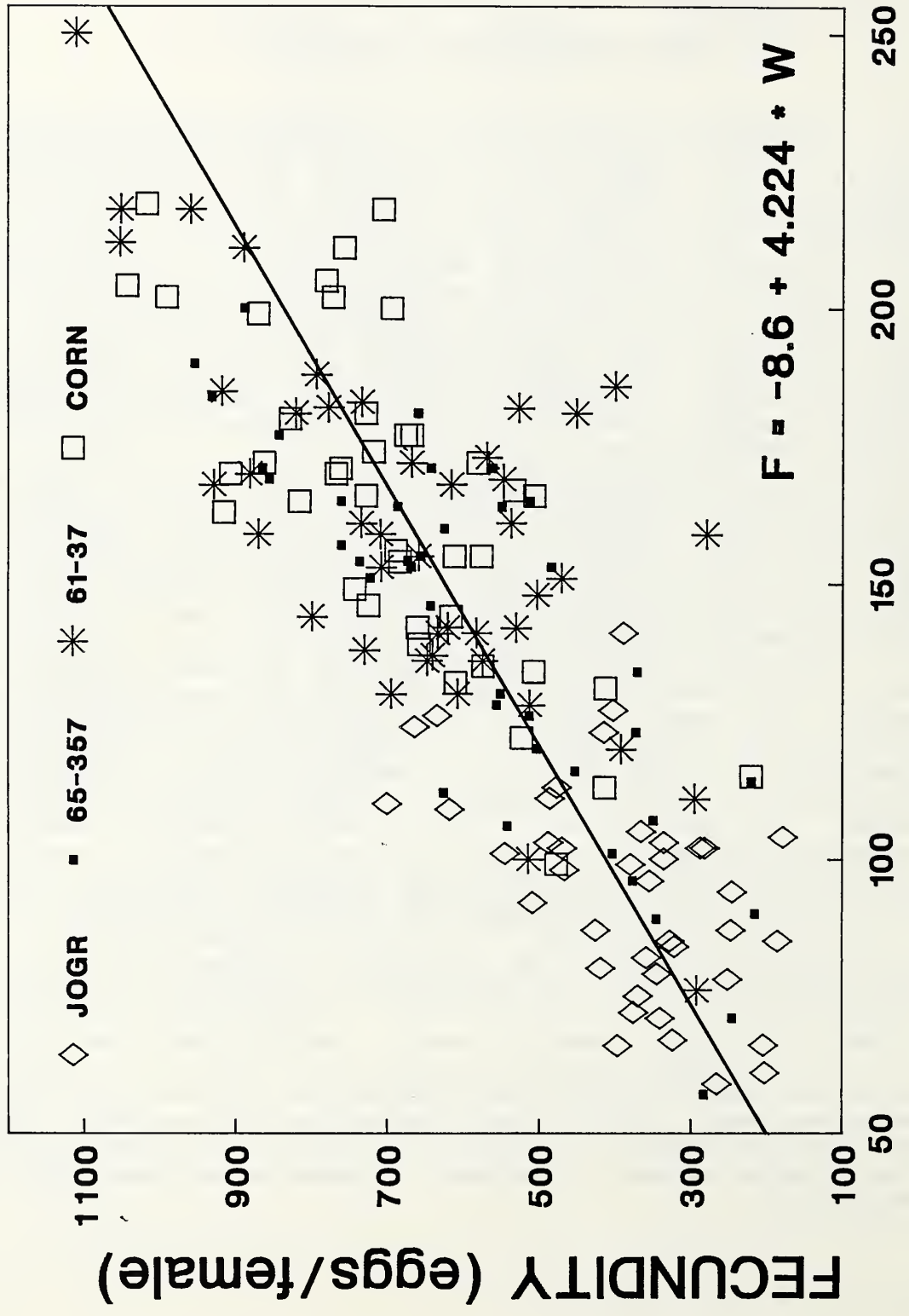
Portion of Annual Report LAES Project 2013

Corresponding to the peak period of Diatraea saccharalis, sugarcane borer, natural infestation (15 August to mid-September), untreated fields of several host plants were examined for the characteristic D. saccharalis adult pre-exit holes. Pupae were obtained and reared from these stalk samples. Data collected during this 2 year study in 1987 and 1988 included pupal weights, lengths, diameter (at the first abdominal segments), and sex of the pupae from the different hosts. The sugarcane borer pupae were reared in special mating cartons (1 pair - ♂ and ♀ per carton) for egg laying comparisons (fecundity) relative to the different plant hosts. Over 600 pupae were obtained from sugarcane varieties CP61-37 (susceptible) and CP65-357 (moderately resistant), hybrid corn "Merit," and johnsongrass in this study conducted on the St. Gabriel Research Station.

When analyzed separately by sex, pupae from the four hosts were significantly different in weight, length, and diameter. Pupae from johnsongrass were separate in all measured parameters from those of other host plants. There also was a trend for the pupae collected from the corn to be larger and heavier than those from the other hosts; and those from the susceptible variety of sugarcane weighed more than pupae from the moderately resistant CP65-357.

The maximum number of eggs produced by a female sugarcane borer moth was 1141, this pair being collected from the susceptible sugarcane variety. The lowest average fecundity was from the johnsongrass moths (396/female). The relationship of fecundity (number of eggs laid per female) to pupal weight by host is shown in the Figure. The regression model shows a linear relationship with the independent variable of weight: No. eggs (F) = -8.6 + 4.224 * Weight (in mg). Because the additional variable of host did not improve the statistical interpretation of this relationship, pupal weight was found to be the best predictive factor for D. saccharalis moth fecundity. The weight variable alone statistically accounted for over 66% of the egg production.

In summary, corn and the susceptible sugarcane variety, CP61-37, were shown to be the most optimal hosts of D. saccharalis in this study. Heavier pupal weight resulted from these two hosts, which in turn led to a greater production of eggs per female. Many pupae were also collected from the johnsongrass weeds surrounding our study area. These borer pupae were smaller, lighter, and produced fewer eggs when the resulting moths were mated. This research indicate that the particular variety and host crop proportions produced in a region have profound impacts on the potential increase or decrease of area-wide sugarcane borer pest populations.


FECUNDITY (eggs/female)
PUPAL WEIGHT (mg)
F = -8.6 + 4.224 * W
JOGR
65-357
61-37
CORN
1100
900
700
500
300
100
50
100
150
200
250

Sugarcane Breeding Progress in 1988

F. A. Martin

Recent progress in sugarcane breeding in the Louisiana Agricultural Experiment Station is a result of an interdisciplinary team effort. Team members (Table 1) contribute expertise in the areas of breeding, genetics, statistics, pathology, entomology and physiology.

The process of sugarcane breeding begins with the characterization of each parent variety for each trait of breeding interest. The group of parent varieties must be made to flower in a synchronized fashion. Knowledge gained during the 1983 - 1986 period regarding photoperiod control of flowering amongst varieties has greatly enhanced our ability to synchronize flowering. Improved synchronization taxed our crossing facilities in 1986. Dividing the crossing campaign into two flowering groups was initiated in 1987 and perfected in 1988. This strategy eliminated the congestion in the crossing greenhouse.

Parental material for the 1988 crossing campaign included proven parent varieties and elite experimental varieties through the CP84 and the L85 assignment series. The 1988 crossing campaign was very successful with a production of 472,000 viable seed. One hundred four genotypes were used in 311 biparental crosses, 21 genotypes in 4 polycrosses and 72 genotypes were selfed.

Because of the successful crossing with the photoperiod house induced tassels and the need to further economize, no crosses were made from tassels that were induced to flower by natural photo- period. These tassels were used to characterized the flowering types of varieties in the L86, CP86 and CP85 assignment series. Varieties that flowered were also rated for pollen production.

In the spring of 1988, 71,507 seedlings representing 169 crosses of the 1987 crossing series were established in the field at the St. Gabriel Research Station. These single stools will be selected in 1989. Three thousand eight hundred ten clones of the 1986 crossing series were selected in single stools and advanced to first line trials. Six hundred two clones of the 1985 crossing series were advanced to second line trials and two hundred ninety nine clones of the 1984 crossing series were advanced to increase plots.

Sixty seven clones of the 1983 crossing series were assigned "L87" numbers. These new experimental varieties were planted in two replicate nurseries at three locations. Thirty two experimental varieties of the L87 series were planted at two locations on the st. Gabriel station, two additional off-station locations and sent to the USDA Sugarcane Research Unit for cooperative testing. Forty experimental varieties of the CP87 series were received from the USDA for planting at the St. Gabriel Station.

Twenty three L86, twenty two CP86, five L85, and five CP85 varieties were planted on commerce silt loam and sharkey clay soils at the St. Gabriel Station. The varieties of the 85 assignment series were also introduced to the outfield test fields[a] and the primary seed increase stations. Two varieties of the L84 series (LCP 84-222 and L84-290) and three varieties of CP84 series (CP84-730, CP84-738, and CP84-746) were planted in the outfield in 1988. Three varieties of the L83 series (LCP83-137, LCP83-149, and LCP83-153) and two varieties of the CP83

series (CP83-625 and CP83-644) were replanted and harvested as plant cane in the outfield. LCP82-89, CP82-550 and CP82-551 were introduced to the secondary seed increase stations and replanted in the outfield. The three varieties were harvested in plant cane and first stubble plots in the outfield.

More details regarding the individual stages of the Louisiana (L) Sugarcane Variety Development Program follow.

Table 1. Members of the LAES sugarcane breeding program.

Member	Budgetary unit	Responsibility
F. A. Martin	Agronomy/Sugar Station	Program leader
J. P. Quebedeaux	Agronomy	Photoperiod + crossing
K. B. Bischoff	Agronomy	Selection
E. O. Dufrene	St. Gabriel Res. Stn.	Infield Variety Testing
H. P. Viator	Iberia Research Stn.	Variety Testing
D. Lester	Sugar Station	Outfield Variety Testing
T. E. Reagan	Entomology	Insect resistance
J. Hoy	Plant Pathology	Disease resistance
A. Saxton	Experimental Statistics	Statistical Genetics
S. B. Milligan	Agronomy	Quantitative Genetics
E. LeBlanc	Sugar Station	Sucrose Laboratory

[a] Outfield variety testing is conducted cooperatively by personnel of Louisiana State University; United States Department of Agriculture, Agricultural Research Service and the American Sugar Cane League according to the provisions of the "three-way agreement of 1978".

Photoperiod and Crossing for the Year 1988

Joey Quebedeaux and F.A. Martin
Agronomy Department

Two-hundred eight varieties of sugarcane were used in the 1988 photoperiod campaign. There were 11 "L" varieties, 55 "LCP" varieties, 110 "CP" varieties selected for Louisiana, 22 "CP" varieties selected for Florida, 6 "US" varieties and 4 "B" varieties. Ninety-seven varieties were of unknown photoperiod response.

In 1987, a successful effort was made to split the flowering season into two peaks. However, the target dates of the two peaks were too far apart for interbreeding of tassels between each peak. In 1988, the target date of the latter peak was moved up two weeks. Bays 1, 2, and 3 contained early to medium flowering varieties targeted to begin flowering around September 26. Bays 4, 5, and 6 contained early to late flowering varieties targeted to begin flowering around October 10.

Sunlight was the sole light source for the 1988 photoperiod treatments. The doors of the photoperiod bays were opened at the prescribed time to start the photoperiod treatments and the carts were pulled from the photoperiod houses. The natural sunset terminated the photoperiod for each day. The carts were pushed into the photoperiod houses after sunset. All bays received induction cycles (constant daylength) of 12 hours and 30 minutes. The number of induction cycles required to initiate flowering, calculated from data gathered from the previous crossing seasons, determined which day the photoperiod treatment was begun for a particular variety/bay situation (Table 1).

Seventy-six early to medium flowering varieties were placed on the nine rail carts in Bays 1, 2, and 3 according to their ease of photoperiod flower induction. Varieties designated for pollen production were placed on the carts in Bay 3 and were heated when ambient temperature fell below 70^{o} F. Results from previous experiments have shown that tassels protected from cool night temperatures flowered earlier than unprotected tassels. Therefore, to synchronize tasseling, the decreasing of photoperiod for Bay 3 commenced 5 days later than that for Bays 1 and 2 (July 10 vs July 5).

Eighty-nine early to late flowering varieties were placed on the nine rail carts in Bays 4, 5, and 6 according to their ease of photoperiod induction. The decreasing of photoperiod

commenced on July 14 for Bays 4 and 6 and on July 24 for Bay 5. Varieties designated for pollen production were placed on carts in Bays 4 and 5 and were heated when ambient temperature fell below 70° F. The photoperiods for Bay 5 and Bay 6 were decreased at the rate of 1 minute per day. However, photoperiod decrease for Bay 6 was begun 10 days earlier because canes on these carts were not protected from cool nights. The decrease for Bay 4 (which contained only pollen producing varieties) was begun 10 days earlier because the rate of decrease was 1/2 minute per day. Results from previous experiments suggested that decreasing the photoperiod at a slower rate produces more viable pollen.

Synchronization of tasseling across all 6 bays was very good (Table 2). The varieties in Bay 4, however, flowered slightly ahead of Bays 5 and 6 which caused a mild shortage of male tassels at the end of the crossing campaign. Crossing from the photoperiod bays began on September 9 and ended on November 4.

The 97 varieties of unknown photoperiod response along with 12 varieties of known photoperiod response were placed on the greenhouse rail system for natural induction. By comparing the date of flowering to those of known varieties, the first approximation of the photoperiod response of the new varieties were made. The pollen producing capacity of each new variety that flowered after natural induction was also estimated. All experimental crosses produced with the new varieties were made available to the variety selection phase of the program.

Anthesis on the greenhouse rail system began on November 30. Flowering of the canes on this system continued until the end of December. At that point, all varieties that had not flowered were examined for signs of induction.

Four-hundred seventy crosses were made during the 1988 crossing campaign (Tables 3,4,5). The majority of these crosses were biparental. Of the 477,084 estimated viable seed produced in 1988, 432,906 were from the biparental crosses. Twenty four polycrosses yielded 17,136 estimated viable seed and 27,042 estimated viable seed were produced via self pollination of the 79 varieties used as male parents.

Table 1. Summary of the 1988 photoperiod treatments.

Bay	Cart	Start Treatment[1/]	Decline Date	Decline Rate[2/]	Heat Status	Target Tasseling Date
1	A	June 23	July 05	1	no	Sept 26
1	B	June 21	" "	1	no	" "
1	C	June 10	" "	1	no	" "
2	A	June 23	" "	1	no	" "
2	B	June 21	" "	1	no	" "
2	C	June 06	" "	1	no	" "
3	A	June 28	July 10	1	yes	" "
3	B	June 16	" "	1	yes	" "
3	C	June 06	" "	1	yes	" "
4	A	June 28	July 14	1/2	yes	Oct 10
4	B	June 18	" "	1/2	yes	" "
4	C	June 06	" "	1/2	yes	" "
5	A	July 06	July 24	1	yes	" "
5	B	June 28	" "	1	yes	" "
5	C	June 23	" "	1	yes	" "
6	A	July 06	July 14	1	no	" "
6	B	June 18	" "	1	no	" "
6	C	June 06	" "	1	no	" "

[1/] Some varieties were removed from the carts prior to the start date due to different photoperiodic response and reinstalled at later dates. Treatments began with constant daylengths of 12 hours and 30 minutes.

[2/] Minutes per day.

Table 2. Minimum days to first flower by bay and variety for 1988[1].

Variety	Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8
B70-734	.	.	.	.	.	.	334	.
B71-941	.	.	.	.	.	.	351	.
B74-725	.	.	.	.	.	.	NONE	.
B76-719	.	.	.	.	.	.	.	342
CP48-103	.	92	.	.	.	.	.	.
CP48-103	.	.	.	104	.	.	.	.
CP48-103	.	.	.	.	97	.	.	.
CP48-103	.	.	.	.	.	118	.	.
CP57-614	.	.	81	.	.	.	.	.
CP57-614	.	.	.	94	.	.	.	.
CP57-614	.	.	.	.	85	.	.	.
CP57-614	.	.	.	.	.	.	.	342
CP61-037	103	.	.	.	.	.	.	.
CP61-037	.	.	.	128	.	.	.	.
CP61-037	.	.	.	.	111	.	.	.
CP61-037	.	.	.	.	.	100	.	.
CP61-037	.	.	.	.	.	.	.	NONE
CP62-258	.	.	99	.	.	.	.	.
CP62-258	.	.	.	119	.	.	.	.
CP62-258	.	.	.	.	100	.	.	.
CP65-357	.	92	.	.	.	.	.	.
CP65-357	.	.	.	114	.	.	.	.
CP65-357	.	.	.	.	101	.	.	.
CP65-357	.	.	.	.	.	312	.	.
CP67-412	.	107	.	.	.	.	.	.
CP67-412	.	.	118	.	.	.	.	.
CP67-412	.	.	.	116	.	.	.	.
CP67-412	.	.	.	.	108	.	.	.
CP67-412	.	.	.	.	.	107	.	.
CP68-1026	.	.	.	.	105	.	.	.
CP69-1052	.	.	.	342	.	.	.	.
CP69-1052	.	.	.	.	342	.	.	.
CP69-373	.	.	.	.	.	94	.	.
CP69-373	.	.	.	.	.	.	.	NONE
CP70-1527	.	.	119	.	.	.	.	.
CP70-321	.	.	.	109	.	.	.	.
CP70-321	.	.	.	.	.	518	.	.
CP70-330	.	90	.	.	.	.	.	.
CP70-330	.	.	.	.	101	.	.	.
CP70-330	.	.	.	.	.	95	.	.
CP70-330	.	.	.	.	.	.	335	.
CP71-1194	.	.	.	.	.	94	.	.
CP71-1449	.	.	.	.	525	.	.	.
CP71-441	.	.	.	.	.	126	.	.
CP72-1210	.	.	102	.	.	.	.	.
CP72-1210	.	.	.	128	.	.	.	.
CP72-1312	98	.	.	.	.	.	.	.
CP72-1312	.	.	102	.	.	.	.	.
CP72-1312	.	.	.	104	.	.	.	.

Table 2. continued.

Variety	Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8
CP72-2086	.	.	.	128	.	.	.	.
CP72-2086	.	.	.	.	119	.	.	.
CP72-2086	.	.	.	.	.	.	INDT	.
CP72-355	.	.	90	.	.	.	.	.
CP72-355	.	.	.	108	.	.	.	.
CP72-355	.	.	.	.	93	.	.	.
CP72-356	98	.	.	.	.	.	.	.
CP72-356	.	.	.	.	94	.	.	.
CP72-356	.	.	.	.	.	92	.	.
CP72-370	97	.	.	.	.	.	.	.
CP72-370	.	97	.	.	.	.	.	.
CP72-370	.	.	.	.	97	.	.	.
CP72-370	.	.	.	.	.	93	.	.
CP72-370	.	.	.	.	.	.	NONE	.
CP73-340	96	.	.	.	.	.	.	.
CP73-340	.	.	.	104	.	.	.	.
CP73-343	.	.	107	.	.	.	.	.
CP73-343	.	.	.	104	.	.	.	.
CP73-343	.	.	.	.	104	.	.	.
CP73-343	.	.	.	.	.	.	.	BOOT
CP73-345	92	.	.	.	.	.	.	.
CP73-345	.	92	.	.	.	.	.	.
CP73-345	.	.	.	.	93	.	.	.
CP73-345	.	.	.	.	.	91	.	.
CP73-351	.	.	.	137	.	.	.	.
CP73-351	.	.	.	.	126	.	.	.
CP73-351	.	.	.	.	.	118	.	.
CP73-351	.	.	.	.	.	.	NONE	.
CP74-1094	.	.	.	128	.	.	.	.
CP74-1094	.	.	.	.	106	.	.	.
CP74-2013	.	.	90	.	.	.	.	.
CP74-2013	.	.	.	97	.	.	.	.
CP74-328	.	.	90	.	.	.	.	.
CP74-383	79	.	.	.	.	.	.	.
CP74-383	.	76	.	.	.	.	.	.
CP74-383	.	.	.	.	89	.	.	.
CP74-383	.	.	.	.	.	82	.	.
CP75-1082	85	.	.	.	.	.	.	.
CP75-1082	.	.	83	.	.	.	.	.
CP75-1082	.	.	.	90	.	.	.	.
CP75-1082	.	.	.	.	89	.	.	.
CP75-1082	.	.	.	.	.	82	.	.
CP75-1632	94	.	.	.	.	.	.	.
CP75-308	.	.	108	.	.	.	.	.
CP75-327	90	.	.	.	.	.	.	.
CP75-327	.	.	.	.	111	.	.	.
CP75-327	.	.	.	.	.	89	.	.
CP75-327	.	.	.	.	.	.	.	351
CP75-330	.	.	98	.	.	.	.	.
CP75-330	.	.	.	109	.	.	.	.

Table 2. continued.

Variety	Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8
CP75-361	.	102	.	.	.	.	.	.
CP75-361	.	.	.	.	99	.	.	.
CP75-361	.	.	.	.	.	95	.	.
CP76-1519	.	.	.	.	325	.	.	.
CP76-331	.	.	81	.	.	.	.	.
CP76-331	.	.	.	85	.	.	.	.
CP76-351	104	.	.	.	.	.	.	.
CP76-351	.	.	.	.	110	.	.	.
CP76-351	.	.	.	.	.	104	.	.
CP77-1055	.	.	.	.	.	.	.	354
CP77-1776	.	.	.	.	.	.	NONE	.
CP77-310	82	.	.	.	.	.	.	.
CP77-310	.	.	85	.	.	.	.	.
CP77-310	.	.	.	96	.	.	.	.
CP77-310	.	.	.	.	93	.	.	.
CP77-310	.	.	.	.	.	87	.	.
CP77-402	.	97	.	.	.	.	.	.
CP77-402	.	.	102	.	.	.	.	.
CP77-402	.	.	.	107	.	.	.	.
CP77-405	85	.	.	.	.	.	.	.
CP77-405	.	83	.	.	.	.	.	.
CP77-405	.	.	.	.	84	.	.	.
CP77-405	.	.	.	.	.	82	.	.
CP77-407	.	88	.	.	.	.	.	.
CP77-407	.	.	83	.	.	.	.	.
CP77-407	.	.	.	104	.	.	.	.
CP77-414	108	.	.	.	.	.	.	.
CP77-414	.	.	542	.	.	.	.	.
CP77-414	.	.	.	.	.	96	.	.
CP78-2114	.	.	.	.	102	.	.	.
CP78-304	.	114	.	.	.	.	.	.
CP78-304	.	.	114	.	.	.	.	.
CP78-304	.	.	.	124	.	.	.	.
CP78-357	99	.	.	.	.	.	.	.
CP78-357	.	.	.	.	.	100	.	.
CP79-318	92	.	.	.	.	.	.	.
CP79-318	.	91	.	.	.	.	.	.
CP79-318	.	.	.	.	.	89	.	.
CP79-332	.	108	.	.	.	.	.	.
CP79-332	.	.	.	.	.	102	.	.
CP79-332	.	.	.	.	.	.	.	BOOT
CP79-348	85	.	.	.	.	.	.	.
CP79-348	.	81	.	.	.	.	.	.
CP79-348	.	.	.	.	82	.	.	.
CP79-348	.	.	.	.	.	82	.	.
CP80-313	92	.	.	.	.	.	.	.
CP80-313	.	102	.	.	.	.	.	.
CP80-313	.	.	.	.	.	93	.	.
CP80-323	.	109	.	.	.	.	.	.
CP80-323	.	.	.	107	.	.	.	.

Table 2. continued.

Variety	Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8
CP80-323	.	.	.	.	100	.	.	.
CP80-323	.	.	.	.	.	93	.	.
CP80-328	94	.	.	.	.	.	.	.
CP80-328	.	.	88	.	.	.	.	.
CP80-328	.	.	.	114	.	.	.	.
CP80-329	103	.	.	.	.	.	.	.
CP80-329	.	.	108	.	.	.	.	.
CP80-329	.	.	.	118	.	.	.	.
CP80-352	78	.	.	.	.	.	.	.
CP80-352	.	.	90	.	.	.	.	.
CP80-352	.	.	.	104	.	.	.	.
CP80-356	.	.	.	.	124	.	.	.
CP81-1254	.	.	.	.	.	.	NONE	.
CP81-1302	.	.	.	.	.	.	NONE	.
CP81-1425	.	.	.	.	.	.	.	344
CP81-1435	.	.	.	.	.	.	.	329
CP81-2062	.	.	.	.	.	.	.	356
CP81-2149	.	.	.	.	.	.	INDT	.
CP81-316	85	.	.	.	.	.	.	.
CP81-316	.	.	.	.	.	82	.	.
CP81-332	.	100	.	.	.	.	.	.
CP82-513	.	.	.	.	104	.	.	.
CP82-513	.	.	.	.	.	95	.	.
CP82-519	.	.	84	.	.	.	.	.
CP82-550	.	100	.	.	.	.	.	.
CP82-550	.	.	.	.	.	95	.	.
CP82-551	.	.	.	.	136	.	.	.
CP82-551	.	.	.	.	.	123	.	.
CP83-606	.	103	.	.	.	.	.	.
CP83-606	.	.	.	.	119	.	.	.
CP83-606	.	.	.	.	.	121	.	.
CP83-607	.	83	.	.	.	.	.	.
CP83-607	.	.	.	.	100	.	.	.
CP83-625	.	.	.	.	520	.	.	.
CP83-625	.	.	.	.	.	523	.	.
CP83-644	.	108	.	.	.	.	.	.
CP84-722	.	.	.	119	.	.	.	.
CP84-730	.	.	.	119	.	.	.	.
CP84-738	.	.	.	342	.	.	.	.
CP84-746	.	.	83	.	.	.	.	.
CP84-755	.	.	.	121	.	.	.	.
CP84-761	.	112	.	.	.	.	.	.
CP84-761	.	.	112	.	.	.	.	.
CP84-772	.	.	.	114	.	.	.	.
CP85-800	.	.	.	.	.	.	NONE	.
CP85-801	.	.	.	.	.	.	INDT	.
CP85-803	.	.	.	.	.	.	.	EMGD
CP85-805	.	.	.	.	.	.	.	INDT
CP85-812	.	.	.	.	.	.	.	340
CP85-830	.	.	.	.	.	.	NONE	.

Table 2. continued.

Variety	Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8
CP85-833	.	.	.	.	.	.	344	.
CP85-845	.	.	.	.	.	.	NONE	.
CP85-846	.	.	.	.	.	.	.	354
CP85-853	.	.	.	.	.	.	.	.
CP85-859	.	.	.	.	.	.	.	337
CP85-860	.	.	.	.	.	.	331	.
CP85-861	.	.	.	.	.	.	NONE	.
CP85-866	.	.	.	.	.	.	NONE	.
CP86-901	.	.	.	.	.	.	INDT	.
CP86-911	.	.	.	.	.	.	354	.
CP86-912	.	.	.	.	.	.	NONE	.
CP86-913	.	.	.	.	.	.	.	340
CP86-915	.	.	.	.	.	.	.	340
CP86-916	.	.	.	.	.	.	NONE	.
CP86-917	.	.	.	.	.	.	347	.
CP86-918	.	.	.	.	.	.	NONE	.
CP86-921	.	.	.	.	.	.	INDT	.
CP86-924	.	.	.	.	.	.	.	349
CP86-925	.	.	.	.	.	.	.	INDT
CP86-926	.	.	.	.	.	.	.	NONE
CP86-927	.	.	.	.	.	.	NONE	.
CP86-929	.	.	.	.	.	.	356	.
CP86-933	.	.	.	.	.	.	NONE	.
CP86-936	.	.	.	.	.	.	.	NONE
CP86-939	.	.	.	.	.	.	.	NONE
CP86-941	.	.	.	.	.	.	.	NONE
CP86-942	.	.	.	.	.	.	INDT	.
CP86-946	.	.	.	.	.	.	NONE	.
CP86-947	.	.	.	.	.	.	NONE	.
CP86-948	.	.	.	.	.	.	.	NONE
CP86-949	.	.	.	.	.	.	.	BOOT
CP86-950	.	.	.	.	.	.	.	NONE
CP86-952	.	.	.	.	.	.	NONE	.
CP86-955	.	.	.	.	.	.	NONE	.
CP86-956	.	.	.	.	.	.	INDT	.
CP86-961	.	.	.	.	.	.	.	NONE
CP86-962	.	.	.	.	.	.	.	329
CP86-964	.	.	.	.	.	.	.	NONE
CP86-967	.	.	.	.	.	.	.	336
CP86-969	.	.	.	.	.	.	NONE	.
CP86-970	.	.	.	.	.	.	NONE	.
CP86-972	.	.	.	.	.	.	.	NONE
CP86-973	.	.	.	.	.	.	.	NONE
CP86-974	.	.	.	.	.	.	.	342
CP86-976	.	.	.	.	.	.	.	NONE
CP86-979	.	.	.	.	.	.	.	NONE
LCP81-005	92	.	.	.	.	.	.	.
LCP81-010	85	.	.	.	.	.	.	.
LCP81-010	.	.	87	.	.	.	.	.
LCP81-010	.	.	.	108	.	.	.	.

Table 2. continued.

Variety	Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8
LCP81-010	.	.	.	.	106	.	.	.
LCP81-010	.	.	.	.	.	84	.	.
LCP81-015	.	94	.	.	.	.	.	.
LCP81-030	88	.	.	.	.	.	.	.
LCP81-030	.	92	.	.	.	.	.	.
LCP81-030	.	.	90	.	.	.	.	.
LCP81-030	.	.	.	119	.	.	.	.
LCP82-033	101	.	.	.	.	.	.	.
LCP82-033	.	.	.	.	.	97	.	.
LCP82-046	88	.	.	.	.	.	.	.
LCP82-046	.	86	.	.	.	.	.	.
LCP82-046	.	.	.	.	98	.	.	.
LCP82-047	.	.	107	.	.	.	.	.
LCP82-047	.	.	.	111	.	.	.	.
LCP82-058	.	.	.	.	134	.	.	.
LCP82-058	.	.	.	.	.	112	.	.
LCP82-089	.	.	103	.	.	.	.	.
LCP83-137	.	.	.	227	.	.	.	.
LCP83-149	.	.	.	136	.	.	.	.
LCP83-149	.	.	.	.	.	342	.	.
LCP83-153	.	.	.	520	.	.	.	.
LCP83-179	.	.	.	.	109	.	.	.
LCP84-215	.	.	.	.	109	.	.	.
LCP84-222	.	.	91	.	.	.	.	.
LCP84-257	.	.	105	.	.	.	.	.
LCP85-298	.	.	.	114	.	.	.	.
LCP85-307	.	.	.	.	112	.	.	.
LCP85-313	.	.	92	.	.	.	.	.
LCP85-316	.	.	.	.	.	107	.	.
LCP85-336	.	103	.	.	.	.	.	.
LCP85-336	.	.	98	.	.	.	.	.
LCP85-336	.	.	.	111	.	.	.	.
LCP85-352	.	.	.	.	.	116	.	.
LCP85-360	77	.	.	.	.	.	.	.
LCP85-376	.	94	.	.	.	.	.	.
LCP85-384	.	.	93	.	.	.	.	.
LCP85-384	.	.	.	107	.	.	.	.
LCP86-391	.	.	.	.	.	95	.	.
LCP86-393	.	.	.	.	.	.	.	NONE
LCP86-394	.	.	.	.	.	.	INDT	.
LCP86-395	.	.	.	.	.	.	342	.
LCP86-402	.	.	.	.	.	.	.	BOOT
LCP86-408	.	.	.	.	.	.	.	NONE
LCP86-411	.	.	.	.	.	.	340	.
LCP86-412	.	.	.	.	.	.	NONE	.
LCP86-414	.	.	.	.	.	.	NONE	.
LCP86-416	.	.	.	.	.	.	.	329
LCP86-419	.	.	.	.	.	.	.	NONE
LCP86-420	.	.	.	.	.	.	.	351
LCP86-426	.	.	.	.	.	.	BOOT	.

Table 2. continued.

Variety	Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8
LCP86-429	.	.	.	.	.	.	.	331
LCP86-431	.	.	.	.	.	.	.	347
LCP86-435	.	.	.	.	.	.	340	.
LCP86-438	.	.	.	.	.	.	NONE	.
LCP86-446	.	.	.	.	.	.	.	.
LCP86-447	.	.	.	.	.	.	.	NONE
LCP86-449	.	.	.	.	.	.	NONE	.
LCP86-450	.	.	.	.	.	.	NONE	.
LCP86-451	.	.	.	.	.	.	.	NONE
LCP86-453	.	.	.	.	.	.	.	EMGD
LCP86-454	.	.	.	.	.	.	NONE	.
LCP86-456	.	.	.	.	.	.	336	.
LCP86-457	.	.	.	.	.	.	344	.
LCP86-458	.	.	.	.	.	.	.	331
LCP86-459	.	.	.	.	.	.	.	.
LCP86-460	.	.	.	.	.	.	.	BOOT
LCP86-463	.	.	.	.	.	.	NONE	.
LCP86-468	.	.	.	.	.	.	NONE	.
L75-002	.	.	112	.	.	.	.	.
L75-056	.	83	.	.	.	.	.	.
L77-038	.	.	.	109	.	.	.	.
L78-035	.	74	.	.	.	.	.	.
L78-035	.	.	.	.	.	.	329	.
L83-193	.	.	.	.	.	109	.	.
L84-266	.	.	.	.	.	102	.	.
L84-273	.	81	.	.	.	.	.	.
L84-273	.	.	.	97	.	.	.	.
L84-275	.	.	90	.	.	.	.	.
L84-275	.	.	.	.	97	.	.	.
L84-276	103	.	.	.	.	.	.	.
L84-276	.	.	.	.	.	104	.	.
L84-290	.	.	92	.	.	.	.	.
L84-290	.	.	.	.	99	.	.	.
L86-439	.	.	.	.	.	.	NONE	.
US74-090	.	.	.	.	.	100	.	.
US77-009	94	.	.	.	.	.	.	.
US77-010	.	.	342	.	.	.	.	.
US77-012	.	.	.	.	.	.	.	329
US77-017	.	87	.	.	.	.	.	.
US77-017	.	.	.	.	99	.	.	.
US78-026	.	.	.	.	.	.	.	331

[1] Non-flowering responses based upon most advanced stage.
[2] BOOT - boot stage; EMGD - emerged; INDT - induced; NONE - no flowering response.

TABLE 3. 1988 CROSSING DATA SORTED BY CROSS NUMBER.

CROSS	FEMALE	MALE	SEED	CROSS	FEMALE	MALE	SEED
XL88-001	LCP85-360	88P1	798	XL88-051	CP71-1194	CP77-405	706
XL88-002	LCP85-376	88P1	299	XL88-052	CP72-356	LCP81-010	26
XL88-003	CP71-1194	88P1	173	XL88-053	CP75-361	LCP81-010	49
XL88-004	L84-273	88P1	245	XL88-054	CP73-340	CP72-356	62
XL88-005	CP71-1194	L78-035	1094	XL88-055	CP75-330	CP72-356	372
XL88-006	CP81-316	L78-035	1011	XL88-056	US77-017	CP72-356	2083
XL88-007	CP81-316	CP77-405	3110	XL88-057	CP83-606	CP81-332	0
XL88-008	CP74-383	L75-056	324	XL88-058	CP80-352	CP81-332	1221
XL88-009	CP79-348	L75-056	291	XL88-059	LCP82-046	CP74-328	689
XL88-010	CP74-383	L75-056	12	XL88-060	LCP85-313	CP74-328	462
XL88-011	CP79-348	L75-056	485	XL88-061	LCP85-384	LCP85-336	5002
XL88-012	CP80-328	L75-056	376	XL88-062	CP72-356	LCP85-336	1912
XL88-013	CP74-383	L75-056	408	XL88-063	CP74-383	LCP85-336	3237
XL88-014	CP80-328	L75-056	1566	XL88-064	LCP85-313	LCP85-336	1043
XL88-015	L84-275	CP77-405	238	XL88-065	CP72-1312	CP72-1312	128
XL88-016	CP75-330	CP77-405	448	XL88-066	CP75-1082	CP75-1082	1872
XL88-017	CP74-328	CP77-405	74	XL88-067	LCP81-010	LCP81-010	52
XL88-018	L84-275	CP77-405	1947	XL88-068	CP72-356	CP72-356	.
XL88-019	CP75-330	CP77-405	570	XL88-069	CP81-332	CP81-332	216
XL88-020	CP75-1632	CP77-405	4768	XL88-070	CP74-328	CP74-328	11
XL88-021	L84-275	CP77-405	98	XL88-071	LCP85-336	LCP85-336	1804
XL88-022	CP75-1632	CP77-405	3220	XL88-072	LCP85-384	LCP81-010	68
XL88-023	CP74-328	CP77-405	767	XL88-073	CP74-383	LCP81-010	8
XL88-024	CP83-607	US77-009	713	XL88-074	LCP85-384	LCP81-010	56
XL88-025	CP84-746	US77-009	22	XL88-075	CP74-383	LCP81-010	19
XL88-026	CP84-746	US77-009	88	XL88-076	LCP85-384	LCP81-010	209
XL88-027	CP84-746	US77-009	20	XL88-077	CP74-383	LCP81-010	99
XL88-028	CP83-607	US77-009	29	XL88-078	CP74-383	LCP81-030	1104
XL88-029	CP82-550	CP81-332	3321	XL88-079	CP80-313	LCP81-030	1067
XL88-030	CP73-340	CP77-310	1806	XL88-080	LCP81-005	LCP81-030	1334
XL88-031	CP74-383	L78-035"	0	XL88-081	L78-035	LCP82-046	442
XL88-032	US77-009	88P2	714	XL88-082	CP80-352	CP77-407	830
XL88-033	L78-035	88P2	629	XL88-083	L84-266	CP77-407	585
XL88-034	L75-056	88P2	98	XL88-084	CP83-606	CP84-746	39
XL88-035	L78-035	L78-035	740	XL88-085	CP75-361	CP75-1082	1123
XL88-036	CP77-405	CP77-405	2090	XL88-086	CP80-328	CP75-1082	8387
XL88-037	L75-056	L75-056	29	XL88-087	CP79-348	CP74-328	374
XL88-038	CP77-310	CP77-310	803	XL88-088	CP70-330	LCP82-047	2408
XL88-039	US77-009	US77-009	810	XL88-089	LCP82-033	CP73-343	4716
XL88-040	CP81-332	CP81-332	632	XL88-090	LCP82-046	CP73-343	918
XL88-041	CP75-361	CP77-310	2531	XL88-091	CP74-383	L84-290	1229
XL88-042	LCP81-010	CP77-310	2848	XL88-092	LCP81-030	LCP81-030	103
XL88-043	CP74-383	CP77-310	1299	XL88-093	CP77-407	CP77-407	0
XL88-044	CP79-348	CP77-310	654	XL88-094	LCP82-046	LCP82-046	0
XL88-045	LCP85-384	CP77-310	216	XL88-095	CP84-746	CP84-746	9
XL88-046	CP74-383	CP72-1312	93	XL88-096	LCP82-047	LCP82-047	1820
XL88-047	CP82-550	CP72-1312	42	XL88-097	CP73-343	CP73-343	391
XL88-048	L84-266	CP75-1082	903	XL88-098	L84-290	L84-290	.
XL88-049	L84-275	CP75-1082	2584	XL88-099	L78-035	L78-035	18
XL88-050	CP80-352	CP77-405	4680	XL88-100	CP65-357	CP77-407	1020

TABLE 3. 1988 CROSSING DATA SORTED BY CROSS NUMBER.

CROSS	FEMALE	MALE	SEED
XL88-101	CP73-345	CP77-407	30
XL88-102	CP65-357	CP77-407	681
XL88-103	CP73-345	CP77-407	346
XL88-104	CP65-357	CP77-407	80
XL88-105	CP73-345	CP77-407	17
XL88-106	CP65-357	LCP85-336	533
XL88-107	CP79-318	LCP85-336	783
XL88-108	CP65-357	LCP85-336	1862
XL88-109	CP79-318	LCP85-336	4288
XL88-110	CP65-357	LCP85-336	1175
XL88-111	CP79-318	LCP85-336	1045
XL88-112	CP75-361	CP80-313	882
XL88-113	LCP85-384	CP80-313	2014
XL88-114	LCP85-384	CP80-329	2856
XL88-115	L84-276	LCP91-030	2090
XL88-117	CP74-383	CP67-412	2470
XL88-118	LCP85-316	CP67-412	755
XL88-119	CP73-345	LCP82-046	902
XL88-120	LCP86-391	LCP82-046	683
XL88-121	CP75-327	CP77-407	277
XL88-122	CP79-318	CP62-258	1185
XL88-123	CP73-345	CP62-258	2854
XL88-124	LCP81-005	CP62-258	2094
XL88-125	CP65-357	CP82-550	184
XL88-126	LCP85-316	CP82-550	65
XL88-127	CP48-103	CP77-310	2147
XL88-128	CP61-037	CP77-310	912
XL88-129	LCP82-033	CP77-310	1487
XL88-130	CP79-318	CP77-405	1246
XL88-131	CP73-345	LCP82-047	5465
XL88-132	CP80-328	L84-290	3654
XL88-133	CP80-313	CP80-313	935
XL88-134	CP80-329	CP80-329	276
XL88-135	CP67-412	CP67-412	94
XL88-136	CP62-258	CP62-258	375
XL88-137	CP82-550	CP82-550	130
XL88-138	CP65-357	CP76-331	2600
XL88-139	CP73-345	CP80-329	623
XL88-140	CP76-351	CP80-329	1824
XL88-141	CP83-644	CP80-329	2455
XL88-142	US77-017	CP75-308	3278
XL88-143	CP79-332	CP62-258	649
XL88-144	CP74-383	CP82-550	162
XL88-145	CP74-383	CP75-1082	1260
XL88-146	CP79-318	CP72-356	1512
XL88-147	CP77-414	CP80-323	1215
XL88-148	CP79-318	CP80-323	3629
XL88-149	CP79-318	LCP84-222	1947
XL88-150	CP76-331	CP76-331	1204
XL88-151	CP75-308	CP75-308	1352
XL88-152	CP80-323	CP80-323	0
XL88-153	LCP84-222	LCP84-222	252
XL88-154	CP79-318	CP67-412	2855
XL88-155	CP80-329	CP77-310	946
XL88-156	CP79-332	CP77-310	1176
XL88-157	CP75-361	CP75-330	977
XL88-158	LCP81-005	CP75-330	668
XL88-159	LCP81-015	LCP81-010	202
XL88-160	CP70-330	LCP81-030	837
XL88-161	CP65-357	CP62-519	386
XL88-162	CP75-361	CP82-519	252
XL88-163	L83-193	88P3	1534
XL88-164	CP72-1312	88P3	661
XL88-165	CP79-318	88P3	3168
XL88-166	CP75-330	88P3	467
XL88-167	CP75-330	CP75-330	0
XL88-168	CP82-519	CP82-519	173
XL88-169	CP79-348	LCP81-030	1740
XL88-170	CP48-103	LCP81-030	1635
XL88-171	US77-017	CP80-329	3338
XL88-172	CP79-332	CP67-412	1551
XL88-173	CP81-316	CP75-308	2781
XL88-174	CP76-351	CP77-407	4379
XL88-175	LCP82-033	CP75-1082	2546
XL88-176	CP74-383	CP75-330	129
XL88-177	CP81-316	CP72-355	2170
XL88-178	CP80-352	CP72-355	.
XL88-179	CP74-383	CP72-355	144
XL88-180	LCP85-307	CP76-331	1017
XL88-181	CP74-383	CP76-331	1525
XL88-182	LCP81-010	LCP82-089	4450
XL88-183	CP79-318	LCP82-089	4134
XL88-184	CP83-644	LCP82-089	5734
XL88-185	CP74-383	LCP82-089	2107
XL88-186	CP77-310	CP84-761	4910
XL88-187	LCP81-005	CP84-761	1297
XL88-188	LCP81-005	CP74-2013	4499
XL88-189	CP72-355	CP77-414	2269
XL88-190	CP79-332	CP72-370	946
XL88-191	CP79-348	CP72-370	191
XL88-192	LCP85-307	CP76-331	702
XL88-193	CP74-383	CP76-331	2642
XL88-194	LCP82-033	CP77-402	1920
XL88-195	CP79-332	CP57-614	2328
XL88-196	CP83-644	CP57-614	1253
XL88-197	CP75-327	LCP85-336	2575
XL88-198	CP61-037	CP72-1312	35
XL88-199	CP75-361	L75-002	2832

TABLE 3. 1988 CROSSING DATA SORTED BY CROSS NUMBER.

CROSS	FEMALE	MALE	SEED
XL88-200	CP72-1210	L83-193	95
XL88-201	CP77-405	88P3	2654
XL88-202	LCP82-058	88P3	561
XL88-203	LCP86-391	88P3	216
XL88-204	CP80-352	88P3	1235
XL88-205	CP72-355	CP72-355	1020
XL88-206	LCP82-089	LCP82-089	1173
XL88-207	CP84-761	CP84-761	694
XL88-208	CP74-2013	CP74-2013	274
XL88-209	CP77-414	CP77-414	189
XL88-210	CP72-370	CP72-370	121
XL88-211	CP77-402	CP77-402	398
XL88-212	CP57-614	CP57-614	90
XL88-213	L75-002	L75-002	95
XL88-214	L83-193	L83-193	60
XL88-215	CP79-332	CP76-331	1053
XL88-216	CP82-513	LCP81-030	730
XL88-217	LCP81-010	LCP81-030	1579
XL88-218	CP79-332	LCP81-030	2916
XL88-219	CP83-606	CP77-310	46
XL88-220	CP72-1210	CP77-310	319
XL88-221	US77-017	CP75-1082	946
XL88-222	CP79-332	L84-290	1714
XL88-223	CP80-352	L84-290	1735
XL88-224	CP74-383	CP78-304	1116
XL88-225	CP73-345	CP78-304	650
XL88-226	CP61-037	CP78-304	733
XL88-227	CP79-332	CP72-356	1672
XL88-228	CP79-332	CP78-357	765
XL88-229	CP61-037	L84-275	600
XL88-230	LCP85-307	CP84-772	2330
XL88-231	CP77-405	88P3	.
XL88-232	CP78-304	CP78-304	15
XL88-233	CP78-357	CP78-357	105
XL88-234	L84-275	L84-275	0
XL88-235	CP84-772	CP84-772	343
XL88-236	CP61-037	L84-290	632
XL88-237	LCP81-010	CP78-357	480
XL88-238	CP79-332	CP78-357	827
XL88-239	CP75-327	CP77-402	802
XL88-240	CP79-348	CP73-343	1110
XL88-241	CP82-513	CP57-614	757
XL88-242	CP82-513	CP74-2013	66
XL88-243	CP82-550	LCP85-298	748
XL88-244	CP80-323	L84-276	741
XL88-245	LCP85-352	L75-002	497
XL88-246	CP72-1312	88P3	0
XL88-247	CP72-1210	88P3	194
XL88-248	CP73-343	88P3	47
XL88-249	LCP85-298	LCP85-298	2116
XL88-250	L84-276	L84-276	683
XL88-251	CP65-357	CP57-614	858
XL88-252	CP79-348	CP57-614	538
XL88-253	CP48-103	CP72-1312	907
XL88-254	CP79-318	CP72-1312	386
XL88-255	CP61-037	CP76-331	459
XL88-256	CP79-332	CP76-331	353
XL88-257	L84-275	CP72-370	441
XL88-258	LCP85-336	CP72-370	1187
XL88-259	CP65-357	CP67-412	791
XL88-260	CP79-332	CP84-722	1342
XL88-261	CP61-037	CP84-722	689
XL88-262	L83-193	CP80-323	1193
XL88-263	CP84-730	CP80-313	583
XL88-264	CP77-407	CP75-1082	2374
XL88-265	CP77-405	CP75-1082	2351
XL88-266	L84-275	CP75-1082	1333
XL88-267	CP79-348	LCP85-384	722
XL88-268	CP75-327	LCP85-384	1008
XL88-269	LCP85-352	CP74-2013	305
XL88-270	CP78-357	L84-273	835
XL88-271	CP70-1527	CP73-340	3045
XL88-272	LCP85-352	CP73-343	840
XL88-273	US74-090	CP78-2114	44
XL88-274	CP61-037	CP72-2086	602
XL88-275	CP84-722	CP84-722	367
XL88-276	LCP85-384	LCP85-384	209
XL88-277	L84-273	L84-273	21
XL88-278	CP73-340	CP73-340	21
XL88-279	CP78-2114	CP78-2114	37
XL88-280	CP72-2086	CP72-2086	60
XL88-281	US77-017	CP70-321	1333
XL88-282	CP72-370	CP70-321	60
XL88-283	CP67-412	CP70-321	165
XL88-284	CP77-310	CP78-304	728
XL88-285	CP73-345	CP78-304	1803
XL88-286	CP72-370	L75-002	367
XL88-287	CP83-606	L75-002	18
XL88-288	CP78-304	LCP82-089	1975
XL88-289	LCP81-030	LCP82-089	2808
XL88-290	CP79-348	CP76-331	834
XL88-291	CP75-361	L77-038	934
XL88-292	LCP82-046	CP57-614	1738
XL88-293	CP80-323	CP72-356	.
XL88-294	CP48-103	L84-275	1529
XL88-295	CP79-318	CP84-755	130
XL88-296	CP76-351	CP84-755	630
XL88-297	CP70-321	CP70-321	0
XL88-298	L77-038	L77-038	106
XL88-299	CP84-755	CP84-755	16
XL88-300	CP75-1082	CP78-304	1179
XL88-301	CP79-332	CP75-330	.

TABLE 3. 1988 CROSSING DATA SORTED BY CROSS NUMBER.

CROSS	FEMALE	MALE	SEED
XL88-302	CP65-357	CP70-330	102
XL88-303	CP77-310	CP84-755	33
XL88-304	CP80-323	LCP82-047	5055
XL88-305	CP84-730	LCP82-047	3878
XL88-306	US77-017	LCP82-047	3630
XL88-307	CP80-313	CP73-343	4312
XL88-308	CP75-361	L84-290	6945
XL88-309	CP65-357	CP75-1082	2993
XL88-310	CP79-318	CP75-1082	6989
XL88-311	CP75-327	CP77-407	315
XL88-312	US74-090	CP74-2013	2243
XL88-313	CP80-329	CP80-323	1907
XL88-314	CP75-327	CP80-323	411
XL88-315	CP75-361	LCP85-336	3717
XL88-316	CP73-345	CP72-2086	715
XL88-317	CP79-318	CP72-2086	576
XL88-318	CP79-318	LCP85-298	561
XL88-319	CP73-345	CP74-1094	2594
XL88-320	CP70-330	CP70-330	0
XL88-321	LCP85-298	LCP85-298	136
XL88-322	CP74-1094	CP74-1094	19
XL88-323	CP65-357	CP77-407	2616
XL88-324	CP70-1527	CP77-407	1310
XL88-325	CP73-345	CP77-407	1818
XL88-326	CP77-310	CP77-407	2264
XL88-327	CP65-357	CP77-402	808
XL88-328	CP71-441	CP77-402	403
XL88-329	CP79-318	CP77-402	2166
XL88-330	CP78-357	CP80-323	659
XL88-331	CP79-348	CP80-323	864
XL88-332	CP65-357	CP80-323	1420
XL88-333	CP74-383	CP80-323	617
XL88-334	CP77-310	CP79-348	82
XL88-335	CP82-513	CP73-343	1612
XL88-336	CP83-606	CP75-330	0
XL88-337	CP69-373	CP74-2013	777
XL88-338	CP67-412	L77-038	558
XL88-339	US77-017	CP48-103	179
XL88-340	CP65-357	L84-290	2243
XL88-341	CP79-318	L84-290	3552
XL88-342	CP77-310	LCP84-215	278
XL88-343	CP72-370	LCP83-179	484
XL88-344	CP79-348	CP79-348	75
XL88-345	CP48-103	CP48-103	122
XL88-346	LCP84-215	LCP84-215	.
XL88-347	LCP83-179	LCP83-179	34
XL88-348	CP71-441	CP80-323	1549
XL88-349	CP73-345	CP76-331	534
XL88-350	CP74-383	CP77-310	627
XL88-351	CP80-323	CP67-412	777
XL88-352	CP74-383	CP67-412	592
XL88-353	CP72-1210	L75-002	819
XL88-354	CP79-332	CP75-1082	359
XL88-355	CP72-1210	LCP85-336	0
XL88-356	CP70-330	CP72-1312	49
XL88-357	CP72-370	LCP82-047	1022
XL88-358	CP72-1210	LCP82-047	1160
XL88-359	CP74-383	CP72-2086	1899
XL88-360	CP61-037	CP70-330	0
XL88-361	CP72-1210	LCP82-046	245
XL88-362	CP77-310	LCP82-046	648
XL88-363	CP61-037	CP74-1094	682
XL88-364	CP72-370	LCP81-010	1133
XL88-365	CP82-513	CP72-355	.
XL88-366	CP78-357	CP77-407	790
XL88-367	CP84-730	CP77-310	589
XL88-368	CP82-551	CP80-323	70
XL88-369	CP77-310	CP80-323	2057
XL88-370	CP61-037	CP67-412	607
XL88-371	CP82-550	LCP82-046	.
XL88-372	CP72-370	CP62-258	1003
XL88-373	CP83-607	CP57-614	2320
XL88-374	CP69-373	LCP83-179	91
XL88-375	CP72-370	CP80-329	148
XL88-376	CP73-351	LCP85-336	1736
XL88-377	CP72-370	L75-002	1170
XL88-378	CP76-351	LCP81-010	1742
XL88-379	CP78-357	LCP81-010	2888
XL88-380	CP65-357	CP80-352	88
XL88-381	CP74-383	CP90-352	53
XL88-382	CP83-606	CP80-323	0
XL88-383	CP74-383	CP80-323	75
XL88-384	CP73-351	CP80-323	860
XL88-385	CP75-1082	CP80-329	2384
XL88-386	CP78-304	CP72-2086	836
XL88-387	CP78-357	CP72-2086	1545
XL88-388	CP73-351	CP72-2086	1417
XL88-389	CP65-357	CP62-258	2218
XL88-390	CP70-330	LCP82-058	441
XL88-391	CP73-345	LCP82-058	1030
XL88-392	CP82-551	CP48-103	0
XL88-393	CP80-352	CP80-352	89
XL88-394	LCP82-058	LCP82-058	58
XL88-395	CP74-1094	LCP83-149	725
XL88-396	CP80-329	LCP83-149	405
XL88-397	CP80-328	CP72-355	781
XL88-398	CP80-352	CP72-355	1526
XL88-399	CP74-383	CP67-412	201
XL88-400	CP74-383	L75-002	1033
XL88-401	CP74-383	CP57-614	2529
XL88-402	CP82-551	LCP81-010	450
XL88-403	LCP81-015	CP80-323	1320

TABLE 3. 1988 CROSSING DATA SORTED BY CROSS NUMBER.

CROSS	FEMALE	MALE	SEED
XL88-404	CP61-037	CP80-323	212
XL88-405	CP69-373	LCP84-257	12
XL88-406	CP69-373	CP78-304	17
XL88-407	CP83-606	CP78-304	46
XL88-408	CP76-351	CP83-607	1307
XL88-409	LCP81-030	CP77-310	1166
XL88-410	CP76-331	88P4	228
XL88-411	CP84-755	88P4	319
XL88-412	CP83-606	88P4	94
XL88-413	CP83-149	CP83-149	608
XL88-414	LCP84-257	LCP84-257	23
XL88-415	CP83-607	CP83-607	0
XL88-416	CP61-037	CP68-1026	1017
XL88-417	CP80-328	LCP83-149	767
XL88-418	CP72-370	LCP83-149	582
XL88-419	CP77-310	LCP81-030	1680
XL88-420	CP65-357	LCP81-030	1443
XL88-421	CP80-329	CP57-614	.
XL88-422	CP75-327	CP57-614	1435
XL88-423	CP80-328	CP80-356	496
XL88-424	CP83-606	CP80-356	16
XL88-425	CP69-373	CP75-1082	23
XL88-426	L84-276	CP48-103	1872
XL88-427	CP80-323	LCP84-215	955
XL88-428	CP80-356	CP80-356	660
XL88-429	CP68-1026	CP68-1026	546
XL88-430	CP61-037	CP80-356	68
XL88-431	CP72-370	CP80-356	144
XL88-432	CP74-383	CP67-412	.
XL88-433	CP70-330	CP73-351	835
XL88-434	CP76-351	LCP84-215	990
XL88-435	CP80-328	CP62-258	918
XL88-436	L84-266	CP76-331	210
XL88-437	CP73-351	CP73-351	0
XL88-438	CP65-357	CP70-321	242
XL88-439	CP72-370	CP77-407	370
XL88-440	CP79-348	CP77-310	74
XL88-441	CP48-103	CP75-1082	924
XL88-442	CP71-441	CP67-412	2001
XL88-443	CP48-103	CP67-412	774
XL88-444	CP73-343	88P4	1706
XL88-445	CP57-614	88P4	1096
XL88-446	CP72-370	CP73-351	112
XL88-447	CP72-1210	CP77-407	909
XL88-448	CP74-383	CP57-614	638
XL88-449	CP81-1435	US78-026	493
XL88-450	CP81-1435	US78-026	2277
XL88-451	CP81-1435	US77-026	1411
XL88-452	US78-026	US78-026	218
XL88-453	LCP86-416	LCP86-416	12
XL88-454	CP85-860	CP85-860	0
XL88-455	US77-012	US77-012	20
XL88-456	CP86-962	CP86-962	.
XL88-457	LCP86-458	CP86-915	0
XL88-458	B70-734	CP86-915	0
XL88-459	CP70-330	CP86-915	0
XL88-460	LCP86-458	CP86-915	18
XL88-461	B70-734	CP86-915	39
XL88-462	CP70-330	CP86-915	0
XL88-463	CP86-915	CP86-915	0
XL88-464	LCP86-429	LCP86-456	120
XL88-465	B70-734	LCP86-456	8
XL88-466	LCP86-429	LCP86-456	102
XL88-467	B70-734	LCP86-456	70
XL88-468	CP70-330	CP86-915	29
XL88-469	LCP86-458	CP86-915	0
XL88-470	LCP86-456	LCP86-456	0
			======
			477084

TABLE 4. 1988 CROSSING DATA SORTED BY FEMALE PARENT.

CROSS	FEMALE	MALE	SEED
XL88-458	B70-734	CP86-915	0
XL88-461	B70-734	CP86-915	39
XL88-465	B70-734	LCP86-456	8
XL88-467	B70-734	LCP86-456	70
XL88-345	CP48-103	CP48-103	122
XL88-443	CP48-103	CP67-412	774
XL88-253	CP48-103	CP72-1312	907
XL88-441	CP48-103	CP75-1082	924
XL88-127	CP48-103	CP77-310	2147
XL88-294	CP48-103	L84-275	1529
XL88-170	CP48-103	LCP81-030	1635
XL88-445	CP57-614	88P4	1096
XL88-212	CP57-614	CP57-614	90
XL88-370	CP61-037	CP67-412	607
XL88-416	CP61-037	CP68-1026	1017
XL88-360	CP61-037	CP70-330	0
XL88-198	CP61-037	CP72-1312	36
XL88-274	CP61-037	CP72-2086	602
XL88-363	CP61-037	CP74-1094	682
XL88-255	CP61-037	CP76-331	459
XL88-128	CP61-037	CP77-310	912
XL88-226	CP61-037	CP78-304	733
XL88-404	CP61-037	CP80-323	212
XL88-430	CP61-037	CP80-356	68
XL88-261	CP61-037	CP84-722	689
XL88-229	CP61-037	L84-275	600
XL88-236	CP61-037	L84-290	632
XL88-136	CP62-258	CP62-258	375
XL88-251	CP65-357	CP57-614	958
XL88-389	CP65-357	CP62-258	2218
XL88-259	CP65-357	CP67-412	791
XL88-438	CP65-357	CP70-321	242
XL88-302	CP65-357	CP70-330	102
XL88-309	CP65-357	CP75-1082	2993
XL88-138	CP65-357	CP76-331	2600
XL88-327	CP65-357	CP77-402	808
XL88-104	CP65-357	CP77-407	80
XL88-102	CP65-357	CP77-407	681
XL88-100	CP65-357	CP77-407	1020
XL88-323	CP65-357	CP77-407	2616
XL88-332	CP65-357	CP80-323	1420
XL88-380	CP65-357	CP80-352	88
XL88-161	CP65-357	CP82-519	386
XL88-125	CP65-357	CP82-550	184
XL88-340	CP65-357	L84-290	2243
XL88-420	CP65-357	LCP81-030	1443
XL88-106	CP65-357	LCP85-336	533
XL88-110	CP65-357	LCP85-336	1175
XL88-108	CP65-357	LCP85-336	1862
XL88-135	CP67-412	CP67-412	94
XL88-283	CP67-412	CP70-321	165
XL88-338	CP67-412	L77-038	558
XL88-429	CP68-1026	CP68-1026	546
XL88-337	CP69-373	CP74-2013	777
XL88-425	CP69-373	CP75-1082	23
XL88-406	CP69-373	CP78-304	17
XL88-374	CP69-373	LCP83-179	81
XL88-405	CP69-373	LCP84-257	12
XL88-271	CP70-1527	CP73-340	3045
XL88-324	CP70-1527	CP77-407	1310
XL88-297	CP70-321	CP70-321	0
XL88-320	CP70-330	CP70-330	0
XL88-356	CP70-330	CP72-1312	49
XL88-433	CP70-330	CP73-351	835
XL88-459	CP70-330	CP86-915	0
XL88-462	CP70-330	CP86-915	0
XL88-468	CP70-330	CP86-915	29
XL88-160	CP70-330	LCP81-030	837
XL88-088	CP70-330	LCP82-047	2408
XL88-390	CP70-330	LCP82-058	441
XL88-003	CP71-1174	88P1	173
XL88-051	CP71-1174	CP77-405	706
XL88-005	CP71-1174	L78-035	1094
XL88-442	CP71-441	CP67-412	2001
XL88-328	CP71-441	CP77-402	403
XL88-348	CP71-441	CP80-323	1549
XL88-247	CP72-1210	88P3	194
XL88-220	CP72-1210	CP77-310	318
XL88-447	CP72-1210	CP77-407	909
XL88-353	CP72-1210	L75-002	819
XL88-200	CP72-1210	L83-193	95
XL88-361	CP72-1210	LCP82-046	245
XL88-358	CP72-1210	LCP82-047	1160
XL88-355	CP72-1210	LCP85-336	0
XL88-246	CP72-1312	88P3	0
XL88-164	CP72-1312	88P3	661
XL88-065	CP72-1312	CP72-1312	128
XL88-380	CP72-2086	CP72-2086	60
XL88-205	CP72-355	CP72-355	1020
XL88-189	CP72-355	CP77-414	2269
XL88-068	CP72-356	CP72-356	.
XL88-052	CP72-356	LCP81-010	26
XL88-062	CP72-356	LCP85-336	1912
XL88-372	CP72-370	CP62-258	1003
XL88-282	CP72-370	CP70-321	60
XL88-210	CP72-370	CP72-370	121
XL88-446	CP72-370	CP73-351	112
XL88-439	CP72-370	CP77-407	370
XL88-375	CP72-370	CP80-329	148
XL88-431	CP72-370	CP80-356	144

TABLE 4. 1988 CROSSING DATA SORTED BY FEMALE PARENT.

CROSS	FEMALE	MALE	SEED
XL88-286	CP72-370	L75-002	367
XL88-377	CP72-370	L75-002	1170
XL88-364	CP72-370	LCP81-010	1133
XL88-357	CP72-370	LCP82-047	1022
XL88-418	CP72-370	LCP83-149	582
XL88-343	CP72-370	LCP83-179	484
XL88-054	CP73-340	CP72-356	62
XL88-278	CP73-340	CP73-340	21
XL88-030	CP73-340	CP77-310	1806
XL88-248	CP73-343	88P3	47
XL88-444	CP73-343	88P4	1706
XL88-097	CP73-343	CP73-343	281
XL88-123	CP73-345	CP62-258	2854
XL88-316	CP73-345	CP72-2086	715
XL88-319	CP73-345	CP74-1094	2594
XL88-349	CP73-345	CP76-331	534
XL88-105	CP73-345	CP77-407	17
XL88-101	CP73-345	CP77-407	30
XL88-103	CP73-345	CP77-407	346
XL88-325	CP73-345	CP77-407	1819
XL88-225	CP73-345	CP78-304	650
XL88-285	CP73-345	CP78-304	1803
XL88-139	CP73-345	CP80-329	623
XL88-119	CP73-345	LCP82-046	902
XL88-131	CP73-345	LCP82-047	5465
XL88-391	CP73-345	LCP82-058	1030
XL88-388	CP73-351	CP72-2086	1417
XL88-437	CP73-351	CP73-351	0
XL88-384	CP73-351	CP80-323	860
XL88-376	CP73-351	LCP85-336	1736
XL88-322	CP74-1094	CP74-1094	19
XL88-395	CP74-1094	LCP83-149	725
XL88-208	CP74-2013	CP74-2013	274
XL88-070	CP74-328	CP74-328	11
XL88-017	CP74-328	CP77-405	74
XL88-023	CP74-328	CP77-405	767
XL88-448	CP74-383	CP57-614	638
XL88-401	CP74-383	CP57-614	2529
XL88-432	CP74-383	CP67-412	.
XL88-399	CP74-383	CP67-412	201
XL88-352	CP74-383	CP67-412	592
XL88-117	CP74-383	CP67-412	2470
XL88-046	CP74-383	CP72-1312	93
XL88-359	CP74-383	CP72-2086	1899
XL88-179	CP74-383	CP72-355	144
XL88-145	CP74-383	CP75-1082	1260
XL88-176	CP74-383	CP75-330	129
XL88-181	CP74-383	CP76-331	1525
XL88-193	CP74-383	CP76-331	2642
XL88-350	CP74-383	CP77-310	627
XL88-043	CP74-383	CP77-310	1299
XL88-224	CP74-383	CP78-304	1116
XL88-383	CP74-383	CP80-323	75
XL88-333	CP74-383	CP80-323	617
XL88-381	CP74-383	CP80-352	53
XL88-144	CP74-383	CP82-550	162
XL88-400	CP74-383	L75-002	1033
XL88-010	CP74-383	L75-056	12
XL88-008	CP74-383	L75-056	324
XL88-013	CP74-383	L75-056	408
XL88-031	CP74-383	L78-035	0
XL88-091	CP74-383	L84-290	1229
XL88-073	CP74-383	LCP81-010	8
XL88-075	CP74-383	LCP81-010	19
XL88-077	CP74-383	LCP81-010	99
XL88-078	CP74-383	LCP81-030	1104
XL88-185	CP74-383	LCP82-089	2107
XL88-063	CP74-383	LCP85-336	3237
XL88-066	CP75-1082	CP75-1082	1872
XL88-300	CP75-1082	CP78-304	1179
XL88-385	CP75-1082	CP80-329	2384
XL88-022	CP75-1632	CP77-405	3220
XL88-020	CP75-1632	CP77-405	4768
XL88-151	CP75-308	CP75-308	1352
XL88-422	CP75-327	CP57-614	1435
XL88-239	CP75-327	CP77-402	802
XL88-121	CP75-327	CP77-407	277
XL88-311	CP75-327	CP77-407	315
XL88-314	CP75-327	CP80-323	411
XL88-197	CP75-327	LCP85-336	2575
XL88-268	CP75-327	LCP85-384	1008
XL88-166	CP75-330	88P3	467
XL88-055	CP75-330	CP72-356	572
XL88-167	CP75-330	CP75-330	0
XL88-016	CP75-330	CP77-405	448
XL88-019	CP75-330	CP77-405	570
XL88-085	CP75-361	CP75-1082	1123
XL88-157	CP75-361	CP75-330	977
XL88-041	CP75-361	CP77-310	2531
XL88-112	CP75-361	CP80-313	982
XL88-162	CP75-361	CP82-519	252
XL88-199	CP75-361	L75-002	2832
XL88-291	CP75-361	L77-038	934
XL88-308	CP75-361	L84-290	6945
XL88-053	CP75-361	LCP81-010	49
XL88-315	CP75-361	LCP85-336	3717
XL88-410	CP76-331	88P4	228
XL88-150	CP76-331	CP76-331	1204
XL88-174	CP76-351	CP77-407	4379
XL88-140	CP76-351	CP80-329	1824
XL88-408	CP76-351	CP83-607	1307
XL88-296	CP76-351	CP84-755	630

TABLE 4. 1988 CROSSING DATA SORTED BY FEMALE PARENT.

CROSS	FEMALE	MALE	SEED	CROSS	FEMALE	MALE	SEED
XL88-378	CP76-351	LCP81-010	1742	XL88-143	CP79-332	CP62-259	649
XL88-434	CP76-351	LCP84-215	990	XL88-172	CP79-332	CP67-412	1551
XL88-039	CP77-310	CP77-310	803	XL88-227	CP79-332	CP72-356	1672
XL88-326	CP77-310	CP77-407	2264	XL88-190	CP79-332	CP72-370	946
XL88-284	CP77-310	CP78-304	729	XL88-354	CP79-332	CP75-1092	359
XL88-334	CP77-310	CP79-348	82	XL88-301	CP79-332	CP75-330	.
XL88-369	CP77-310	CP80-323	2057	XL88-256	CP79-332	CP76-331	353
XL88-303	CP77-310	CP84-755	33	XL88-215	CP79-332	CP76-331	1053
XL88-186	CP77-310	CP84-761	4910	XL88-156	CP79-332	CP77-310	1176
XL88-419	CP77-310	LCP81-030	1680	XL88-228	CP79-332	CP78-357	765
XL88-362	CP77-310	LCP82-046	648	XL88-238	CP79-332	CP78-357	827
XL88-342	CP77-310	LCP84-215	278	XL88-260	CP79-332	CP84-722	1342
XL88-211	CP77-402	CP77-402	398	XL88-222	CP79-332	L84-290	1714
XL88-231	CP77-405	88P3	.	XL88-218	CP79-332	LCP81-030	2916
XL88-201	CP77-405	89P3	2654	XL88-252	CP79-348	CP57-614	538
XL88-265	CP77-405	CP75-1082	2351	XL88-191	CP79-348	CP72-370	191
XL88-036	CP77-405	CP77-405	2090	XL88-240	CP79-348	CP73-343	1110
XL88-264	CP77-407	CP75-1082	2374	XL88-087	CP79-348	CP74-328	374
XL88-093	CP77-407	CP77-407	0	XL88-290	CP79-348	CP76-331	834
XL88-209	CP77-414	CP77-414	189	XL88-440	CP79-348	CP77-310	74
XL88-147	CP77-414	CP80-323	1215	XL88-044	CP79-348	CP77-310	654
XL88-279	CP78-2114	CP78-2114	37	XL88-344	CP79-348	CP79-348	75
XL88-386	CP78-304	CP72-2086	836	XL88-331	CP79-348	CP80-323	864
XL88-232	CP78-304	CP78-304	15	XL88-009	CP79-348	L75-056	291
XL88-288	CP78-304	LCP82-089	1975	XL88-011	CP79-348	L75-056	485
XL88-387	CP78-357	CP72-2086	1545	XL88-169	CP79-348	LCP81-030	1740
XL88-366	CP78-357	CP77-407	790	XL88-267	CP79-348	LCP85-384	722
XL88-233	CP78-357	CP78-357	105	XL88-307	CP80-313	CP73-343	4312
XL88-330	CP78-357	CP80-323	659	XL88-133	CP80-313	CP80-313	935
XL88-270	CP78-357	L84-273	835	XL88-079	CP80-313	LCP81-030	1067
XL88-379	CP78-357	LCP81-010	2898	XL88-351	CP80-323	CP67-412	777
XL88-165	CP79-318	88P3	3168	XL88-293	CP80-323	CP72-356	.
XL88-122	CP79-318	CP62-258	1185	XL88-152	CP80-323	CP80-323	0
XL88-154	CP79-318	CP67-412	2855	XL88-244	CP80-323	L84-276	741
XL88-254	CP79-318	CP72-1312	386	XL88-304	CP80-323	LCP82-047	5055
XL88-317	CP79-318	CP72-2086	576	XL88-427	CP80-323	LCP84-215	955
XL88-146	CP79-318	CP72-356	1512	XL88-435	CP80-328	CP62-258	918
XL88-310	CP79-318	CP75-1082	6939	XL88-397	CP80-328	CP72-355	781
XL88-329	CP79-318	CP77-402	2166	XL88-086	CP80-328	CP75-1082	2387
XL88-130	CP79-318	CP77-405	1246	XL88-155	CP80-328	CP77-310	946
XL88-148	CP79-318	CP80-323	3629	XL88-423	CP80-328	CP80-356	496
XL88-295	CP79-318	CP84-755	130	XL88-012	CP80-328	L75-056	376
XL88-341	CP79-318	L84-290	3552	XL88-014	CP80-328	L75-056	1566
XL88-183	CP79-318	LCP82-089	4134	XL88-132	CP80-328	L84-290	3654
XL88-149	CP79-318	LCP84-222	1947	XL88-417	CP80-328	LCP83-149	767
XL88-318	CP79-318	LCP85-298	561	XL88-421	CP80-329	CP57-614	.
XL88-107	CP79-318	LCP85-336	783	XL88-313	CP80-329	CP80-323	1907
XL88-111	CP79-318	LCP85-336	1045	XL88-134	CP80-329	CP80-329	276
XL88-109	CP79-318	LCP85-336	4288	XL88-396	CP80-329	LCP83-149	405
XL88-195	CP79-332	CP57-614	2328	XL88-204	CP80-352	88P3	1235

TABLE 4. 1988 CROSSING DATA SORTED BY FEMALE PARENT.

CROSS	FEMALE	MALE	SEED
XL88-178	CP80-352	CP72-355	.
XL88-398	CP80-352	CP72-355	1526
XL88-050	CP80-352	CP77-405	4680
XL88-082	CP80-352	CP77-407	880
XL88-393	CP80-352	CP80-352	89
XL88-058	CP80-352	CP81-332	1221
XL88-223	CP80-352	L84-290	1735
XL88-428	CP80-356	CP80-356	660
XL88-451	CP81-1435	US77-026	1411
XL88-449	CP81-1435	US78-026	493
XL88-450	CP81-1435	US78-026	2277
XL88-177	CP81-316	CP72-355	2170
XL88-173	CP81-316	CP75-308	2781
XL88-007	CP81-316	CP77-405	3110
XL88-006	CP81-316	L78-035	1011
XL88-069	CP81-332	CP81-332	216
XL88-040	CP81-332	CP81-332	632
XL88-241	CP82-513	CP57-614	757
XL88-365	CP82-513	CP72-355	.
XL88-335	CP82-513	CP73-343	1612
XL88-242	CP82-513	CP74-2013	66
XL88-216	CP82-513	LCP81-030	730
XL88-168	CP82-519	CP82-519	173
XL88-047	CP82-550	CP72-1312	42
XL88-029	CP82-550	CP81-332	3321
XL88-137	CP82-550	CP82-550	130
XL88-371	CP82-550	LCP82-046	.
XL88-243	CP82-550	LCP85-298	748
XL88-392	CP82-551	CP48-103	0
XL88-368	CP82-551	CP80-323	70
XL88-402	CP82-551	LCP81-010	450
XL88-413	CP83-149	CP83-149	608
XL88-412	CP83-606	88P4	94
XL88-336	CP83-606	CP75-330	0
XL88-219	CP83-606	CP77-310	46
XL88-407	CP83-606	CP78-304	46
XL88-382	CP83-606	CP80-323	0
XL88-424	CP83-606	CP80-356	16
XL88-057	CP83-606	CP81-332	0
XL88-084	CP83-606	CP84-746	39
XL88-287	CP83-606	L75-002	18
XL88-373	CP83-607	CP57-614	2320
XL88-415	CP83-607	CP83-607	0
XL88-028	CP83-607	US77-009	29
XL88-024	CP83-607	US77-009	713
XL88-196	CP83-644	CP57-614	1263
XL88-141	CP83-644	CP80-329	2455
XL88-184	CP83-644	LCP82-089	5734
XL88-275	CP84-722	CP84-722	367
XL88-367	CP84-730	CP77-310	589
XL88-263	CP84-730	CP80-313	583
XL88-305	CP84-730	LCP82-047	3878
XL88-095	CP84-746	CP84-746	9
XL88-027	CP84-746	US77-009	20
XL88-025	CP84-746	US77-009	22
XL88-026	CP84-746	US77-009	38
XL88-411	CP84-755	88P4	319
XL88-299	CP84-755	CP84-755	16
XL88-207	CP84-761	CP84-761	694
XL88-235	CP84-772	CP84-772	343
XL88-454	CP85-860	CP85-860	0
XL88-463	CP86-915	CP86-915	0
XL88-456	CP86-962	CP86-962	.
XL88-213	L75-002	L75-002	95
XL88-034	L75-056	88P2	98
XL88-037	L75-056	L75-056	29
XL88-298	L77-038	L77-038	106
XL88-033	L78-035	88P2	629
XL88-099	L78-035	L78-035	19
XL88-035	L78-035	L78-035	740
XL88-081	L78-035	LCP82-046	442
XL88-163	L83-193	88P3	1534
XL88-262	L83-193	CP80-323	1193
XL88-214	L83-193	L83-193	60
XL88-048	L84-266	CP75-1082	903
XL88-436	L84-266	CP76-331	210
XL88-083	L84-266	CP77-407	585
XL88-004	L84-273	88P1	245
XL88-277	L84-273	L84-273	21
XL88-257	L84-275	CP72-370	441
XL88-266	L84-275	CP75-1082	1333
XL88-049	L84-275	CP75-1082	2584
XL88-021	L84-275	CP77-405	98
XL88-015	L84-275	CP77-405	238
XL88-018	L84-275	CP77-405	1947
XL88-234	L84-275	L84-275	0
XL88-426	L84-276	CP48-103	1872
XL88-250	L84-276	L84-276	633
XL88-115	L84-276	LCP81-030	2090
XL88-098	L84-290	L84-290	.
XL88-124	LCP81-005	CP62-258	2094
XL88-188	LCP81-005	CP74-2013	4499
XL88-158	LCP81-005	CP75-330	668
XL88-187	LCP81-005	CP84-761	1297
XL88-080	LCP81-005	LCP81-030	1334
XL88-042	LCP81-010	CP77-310	2848
XL88-237	LCP81-010	CP78-357	480
XL88-067	LCP81-010	LCP81-010	52
XL88-217	LCP81-010	LCP81-030	1579
XL88-182	LCP81-010	LCP82-089	4450

TABLE 4. 1988 CROSSING DATA SORTED BY FEMALE PARENT.

CROSS	FEMALE	MALE	SEED
XL88-403	LCP81-015	CP90-323	1320
XL88-159	LCP81-015	LCP81-010	202
XL88-409	LCP81-030	CP77-310	1166
XL88-092	LCP81-030	LCP81-030	103
XL88-289	LCP81-030	LCP82-089	2808
XL88-089	LCP82-033	CP73-343'	4716
XL88-175	LCP82-033	CP75-1082	2546
XL88-129	LCP82-033	CP77-310	1487
XL88-194	LCP82-033	CP77-402	1920
XL88-292	LCP82-046	CP57-614	1738
XL88-090	LCP82-046	CP73-343	918
XL88-059	LCP82-046	CP74-328	689
XL88-094	LCP82-046	LCP82-046	0
XL88-096	LCP82-047	LCP82-047	1820
XL88-202	LCP82-058	88P3	561
XL88-394	LCP82-058	LCP82-058	58
XL88-206	LCP82-089	LCP82-089	1173
XL88-347	LCP83-179	LCP83-179	34
XL88-346	LCP84-215	LCP84-215	.
XL88-153	LCP84-222	LCP84-222	252
XL88-414	LCP84-257	LCP84-257	23
XL88-321	LCP85-298	LCP85-298	136
XL88-249	LCP85-298	LCP85-298	2116
XL88-192	LCP85-307	CP76-331	702
XL88-180	LCP85-307	CP76-331	1017
XL88-230	LCP85-307	CP84-772	2330
XL88-060	LCP85-313	CP74-328	462
XL88-064	LCP85-313	LCP85-336	1043
XL88-118	LCP85-316	CP67-412	755
XL88-126	LCP85-316	CP82-550	65
XL88-258	LCP85-336	CP72-370	1187
XL88-071	LCP85-336	LCP85-336	1804
XL88-272	LCP85-352	CP73-343	840
XL88-269	LCP85-352	CP74-2013	305
XL88-245	LCP85-352	L75-002	497
XL88-001	LCP85-360	88P1	798
XL88-002	LCP85-376	88P1	299
XL88-045	LCP85-384	CP77-310	216
XL88-113	LCP85-384	CP80-313	2014
XL88-114	LCP85-384	CP80-329	2856
XL88-074	LCP85-384	LCP81-010	56
XL88-072	LCP85-384	LCP81-010	68
XL88-076	LCP85-384	LCP81-010	209
XL88-061	LCP85-384	LCP85-336	5002
XL88-276	LCP85-384	LCP85-384	209
XL88-203	LCP86-391	88P3	216
XL88-120	LCP86-391	LCP82-046	683
XL88-453	LCP86-416	LCP86-416	12
XL88-466	LCP86-429	LCP86-456	102
XL88-464	LCP86-429	LCP86-456	120
XL88-470	LCP86-456	LCP86-456	0
XL88-457	LCP86-458	CP86-915	0
XL88-469	LCP86-458	CP86-915	0
XL88-460	LCP86-458	CP86-915	18
XL88-312	US74-090	CP74-2013	2243
XL88-273	US74-090	CP78-2114	44
XL88-032	US77-009	88P2	714
XL88-039	US77-009	US77-009	810
XL88-455	US77-012	US77-012	20
XL88-339	US77-017	CP48-103	179
XL88-281	US77-017	CP70-321	1333
XL88-056	US77-017	CP72-356	2083
XL88-221	US77-017	CP75-1082	946
XL88-142	US77-017	CP75-308	3278
XL88-171	US77-017	CP80-329	3338
XL88-306	US77-017	LCP82-047	3630
XL88-452	US78-026	US78-026	218
			======
			477084

TABLE 5. 1988 CROSSING DATA SORTED BY MALE PARENT.

CROSS	FEMALE	MALE	SEED	CROSS	FEMALE	MALE	SEED
XL88-003	CP71-1194	88P1	173	XL88-259	CP65-357	CP67-412	791
XL88-004	L84-273	88P1	245	XL88-135	CP67-412	CP67-412	94
XL88-001	LCP85-360	88P1	798	XL88-442	CP71-441	CP67-412	2001
XL88-002	LCP85-376	88P1	299	XL88-432	CP74-383	CP67-412	.
XL88-034	L75-056	88P2	98	XL88-399	CP74-383	CP67-412	201
XL88-033	L78-035	88P2	629	XL88-352	CP74-383	CP67-412	592
XL88-032	US77-009	88P2	714	XL88-117	CP74-383	CP67-412	2470
XL88-247	CP72-1210	88P3	194	XL88-154	CP79-318	CP67-412	2355
XL88-246	CP72-1312	88P3	0	XL88-172	CP79-332	CP67-412	1551
XL88-164	CP72-1312	88P3	661	XL88-351	CP80-323	CP67-412	777
XL88-248	CP73-343	88P3	47	XL88-118	LCP85-316	CP67-412	755
XL88-166	CP75-330	88P3	467	XL88-416	CP61-037	CP68-102	1017
XL88-231	CP77-405	88P3	.	XL88-429	CP68-1026	CP68-102	546
XL88-201	CP77-405	88P3	2654	XL88-438	CP65-357	CP70-321	242
XL88-165	CP79-318	88P3	3168	XL88-283	CP67-412	CP70-321	165
XL88-204	CP80-352	88P3	1235	XL88-297	CP70-321	CP70-321	0
XL88-163	L83-193	88P3	1534	XL88-282	CP72-370	CP70-321	60
XL88-202	LCP82-058	88P3	561	XL88-281	US77-017	CP70-321	1333
XL88-203	LCP86-391	88P3	216	XL88-360	CP61-037	CP70-330	0
XL88-445	CP57-614	88P4	1096	XL88-302	CP65-357	CP70-330	102
XL88-444	CP73-343	88P4	1706	XL88-320	CP70-330	CP70-330	0
XL88-410	CP76-331	88P4	228	XL88-253	CP48-103	CP72-1312	907
XL88-412	CP83-606	88P4	94	XL88-198	CP61-037	CP72-1312	36
XL88-411	CP84-755	88P4	319	XL88-356	CP70-330	CP72-1312	49
XL88-345	CP48-103	CP48-103	122	XL88-065	CP72-1312	CP72-1312	128
XL88-392	CP82-551	CP48-103	0	XL88-046	CP74-383	CP72-1312	93
XL88-426	L84-276	CP48-103	1872	XL88-254	CP79-318	CP72-1312	386
XL88-339	US77-017	CP48-103	179	XL88-047	CP82-550	CP72-1312	42
XL88-212	CP57-614	CP57-614	90	XL88-274	CP61-037	CP72-2086	602
XL88-251	CP65-357	CP57-614	858	XL88-280	CP72-2086	CP72-2086	60
XL88-449	CP74-383	CP57-614	638	XL88-316	CP73-345	CP72-2086	715
XL88-401	CP74-383	CP57-614	2529	XL88-388	CP73-351	CP72-2086	1417
XL88-422	CP75-327	CP57-614	1435	XL88-359	CP74-383	CP72-2086	1899
XL88-195	CP79-332	CP57-614	2328	XL88-386	CP78-304	CP72-2086	836
XL88-252	CP79-348	CP57-614	538	XL88-387	CP78-357	CP72-2086	1545
XL88-421	CP80-329	CP57-614	.	XL88-317	CP79-318	CP72-2086	576
XL88-241	CP82-513	CP57-614	757	XL88-205	CP72-355	CP72-355	1020
XL88-373	CP83-607	CP57-614	2320	XL88-179	CP74-383	CP72-355	144
XL88-196	CP83-644	CP57-614	1263	XL88-397	CP80-328	CP72-355	781
XL88-292	LCP82-046	CP57-614	1738	XL88-178	CP80-352	CP72-355	.
XL88-136	CP62-258	CP62-258	375	XL88-398	CP80-352	CP72-355	1526
XL88-389	CP65-357	CP62-258	2218	XL88-177	CP81-316	CP72-355	2170
XL88-372	CP72-370	CP62-258	1003	XL88-365	CP82-513	CP72-355	.
XL88-123	CP73-345	CP62-258	2854	XL88-068	CP72-356	CP72-356	.
XL88-122	CP79-318	CP62-258	1185	XL88-054	CP73-340	CP72-356	62
XL88-143	CP79-332	CP62-258	649	XL88-055	CP75-330	CP72-356	572
XL88-435	CP80-328	CP62-258	918	XL88-146	CP79-318	CP72-356	1512
XL88-124	LCP81-005	CP62-258	2094	XL88-227	CP79-332	CP72-356	1672
XL88-443	CP48-103	CP67-412	774	XL88-293	CP80-323	CP72-356	.
XL88-370	CP61-037	CP67-412	607	XL88-056	US77-017	CP72-356	2083

TABLE 5. 1988 CROSSING DATA SORTED BY MALE PARENT.

CROSS	FEMALE	MALE	SEED
XL88-210	CP72-370	CP72-370	121
XL88-190	CP79-332	CP72-370	946
XL88-191	CP79-348	CP72-370	191
XL88-257	L84-275	CP72-370	441
XL88-258	LCP85-336	CP72-370	1187
XL88-271	CP70-1527	CP73-340	3045
XL88-278	CP73-340	CP73-340	21
XL88-097	CP73-343	CP73-343	281
XL88-240	CP79-348	CP73-343	1110
XL88-307	CP80-313	CP73-343	4312
XL88-335	CP82-513	CP73-343	1612
XL88-089	LCP82-033	CP73-343	4716
XL88-090	LCP82-046	CP73-343	918
XL88-272	LCP85-352	CP73-343	840
XL88-433	CP70-330	CP73-351	835
XL88-446	CP72-370	CP73-351	112
XL88-437	CP73-351	CP73-351	0
XL88-363	CP61-037	CP74-1094	682
XL88-319	CP73-345	CP74-1094	2594
XL88-322	CP74-1094	CP74-1094	19
XL88-337	CP69-373	CP74-2013	777
XL88-208	CP74-2013	CP74-2013	274
XL88-242	CP82-513	CP74-2013	66
XL88-188	LCP81-005	CP74-2013	4499
XL88-269	LCP85-352	CP74-2013	305
XL88-312	US74-090	CP74-2013	2243
XL88-070	CP74-328	CP74-328	11
XL88-087	CP79-348	CP74-328	374
XL88-059	LCP82-046	CP74-328	689
XL88-060	LCP85-313	CP74-328	462
XL88-441	CP48-103	CP75-1082	924
XL88-309	CP65-357	CP75-1082	2993
XL88-425	CP69-373	CP75-1082	23
XL88-145	CP74-383	CP75-1082	1260
XL88-066	CP75-1082	CP75-1082	1872
XL88-085	CP75-361	CP75-1082	1123
XL88-265	CP77-405	CP75-1082	2351
XL88-264	CP77-407	CP75-1082	2374
XL88-310	CP79-318	CP75-1082	6989
XL88-354	CP79-332	CP75-1082	359
XL88-086	CP80-328	CP75-1082	2387
XL88-048	L84-266	CP75-1082	903
XL88-266	L84-275	CP75-1082	1333
XL88-049	L84-275	CP75-1082	2594
XL88-175	LCP82-033	CP75-1082	2546
XL88-221	US77-017	CP75-1082	946
XL88-151	CP75-308	CP75-308	1352
XL88-173	CP81-316	CP75-308	2791
XL88-142	US77-017	CP75-308	3278
XL98-176	CP74-383	CP75-330	129
XL88-167	CP75-330	CP75-330	0
XL88-157	CP75-361	CP75-330	977
XL88-301	CP79-332	CP75-330	.
XL88-336	CP83-606	CP75-330	0
XL88-158	LCP81-005	CP75-330	668
XL88-255	CP61-037	CP76-331	459
XL88-138	CP65-357	CP76-331	2600
XL88-349	CP73-345	CP76-331	534
XL88-181	CP74-383	CP76-331	1525
XL88-193	CP74-383	CP76-331	2642
XL88-150	CP76-331	CP76-331	1204
XL88-256	CP79-332	CP76-331	353
XL88-215	CP79-332	CP76-331	1053
XL88-290	CP79-348	CP76-331	834
XL88-436	L84-266	CP76-331	210
XL88-192	LCP85-307	CP76-331	702
XL88-180	LCP85-307	CP76-331	1017
XL88-127	CP48-103	CP77-310	2147
XL88-128	CP61-037	CP77-310	912
XL88-220	CP72-1210	CP77-310	318
XL88-030	CP73-340	CP77-310	1806
XL88-350	CP74-383	CP77-310	627
XL88-043	CP74-383	CP77-310	1299
XL88-041	CP75-361	CP77-310	2531
XL88-038	CP77-310	CP77-310	803
XL88-156	CP79-332	CP77-310	1176
XL88-440	CP79-348	CP77-310	74
XL88-044	CP79-348	CP77-310	654
XL88-155	CP80-328	CP77-310	946
XL88-219	CP83-606	CP77-310	46
XL88-367	CP84-730	CP77-310	589
XL88-042	LCP81-010	CP77-310	2848
XL88-409	LCP81-030	CP77-310	1166
XL88-129	LCP82-033	CP77-310	1487
XL88-045	LCP85-384	CP77-310	216
XL88-327	CP65-357	CP77-402	808
XL88-328	CP71-441	CP77-402	403
XL88-239	CP75-327	CP77-402	802
XL88-211	CP77-402	CP77-402	398
XL88-329	CP79-318	CP77-402	2166
XL88-194	LCP82-033	CP77-402	1920
XL88-051	CP71-1194	CP77-405	706
XL88-017	CP74-328	CP77-405	74
XL88-023	CP74-328	CP77-405	767
XL88-022	CP75-1632	CP77-405	3220
XL88-020	CP75-1632	CP77-405	4768
XL88-016	CP75-330	CP77-405	448
XL88-019	CP75-330	CP77-405	570
XL88-036	CP77-405	CP77-405	2090
XL88-130	CP79-318	CP77-405	1246

TABLE 5. 1988 CROSSING DATA SORTED BY MALE PARENT.

CROSS	FEMALE	MALE	SEED
XL88-050	CP80-352	CP77-405	4680
XL88-007	CP81-316	CP77-405	3110
XL88-021	L84-275	CP77-405	98
XL88-015	L84-275	CP77-405	238
XL88-018	L84-275	CP77-405	1947
XL88-104	CP65-357	CP77-407	80
XL88-102	CP65-357	CP77-407	681
XL88-100	CP65-357	CP77-407	1020
XL88-323	CP65-357	CP77-407	2616
XL88-324	CP70-1527	CP77-407	1310
XL88-447	CP72-1210	CP77-407	909
XL88-439	CP72-370	CP77-407	370
XL88-105	CP73-345	CP77-407	17
XL88-101	CP73-345	CP77-407	30
XL88-103	CP73-345	CP77-407	346
XL88-325	CP73-345	CP77-407	1818
XL88-121	CP75-327	CP77-407	277
XL88-311	CP75-327	CP77-407	315
XL88-174	CP76-351	CP77-407	4379
XL88-326	CP77-310	CP77-407	2264
XL88-093	CP77-407	CP77-407	0
XL88-366	CP78-357	CP77-407	790
XL88-082	CP80-352	CP77-407	880
XL88-083	L84-266	CP77-407	585
XL88-189	CP72-355	CP77-414	2269
XL88-209	CP77-414	CP77-414	189
XL88-279	CP78-2114	CP78-2114	37
XL88-273	US74-090	CP78-2114	44
XL88-226	CP61-037	CP78-304	733
XL88-406	CP69-373	CP78-304	17
XL88-225	CP73-345	CP78-304	650
XL88-285	CP73-345	CP78-304	1603
XL88-224	CP74-383	CP78-304	1116
XL88-300	CP75-1082	CP78-304	1179
XL88-284	CP77-310	CP78-304	728
XL88-232	CP78-304	CP78-304	15
XL88-407	CP83-606	CP78-304	46
XL88-233	CP78-357	CP78-357	105
XL88-228	CP79-332	CP78-357	765
XL88-238	CP79-332	CP78-357	827
XL88-237	LCP81-010	CP78-357	480
XL88-334	CP77-310	CP79-348	82
XL88-344	CP79-348	CP79-348	75
XL88-112	CP75-361	CP80-313	882
XL88-133	CP80-313	CP80-313	935
XL88-263	CP84-730	CP80-313	583
XL88-113	LCP85-384	CP80-313	2014
XL88-404	CP61-037	CP80-323	212
XL88-332	CP65-357	CP80-323	1420
XL88-348	CP71-441	CP80-323	1549
XL88-384	CP73-351	CP80-323	860
XL88-383	CP74-383	CP80-323	75
XL88-333	CP74-383	CP80-323	617
XL88-314	CP75-327	CP80-323	411
XL88-369	CP77-310	CP80-323	2057
XL88-147	CP77-414	CP80-323	1215
XL88-330	CP78-357	CP80-323	659
XL88-148	CP79-318	CP80-323	3629
XL88-331	CP79-348	CP80-323	864
XL88-152	CP80-323	CP80-323	0
XL88-313	CP80-329	CP80-323	1907
XL88-368	CP82-551	CP80-323	70
XL88-382	CP83-606	CP80-323	0
XL88-262	L83-193	CP80-323	1193
XL88-403	LCP81-015	CP80-323	1320
XL88-375	CP72-370	CP80-329	148
XL88-139	CP73-345	CP80-329	623
XL88-385	CP75-1082	CP80-329	2384
XL88-140	CP76-351	CP80-329	1824
XL88-134	CP80-329	CP80-329	276
XL88-141	CP83-644	CP80-329	2455
XL88-114	LCP85-384	CP80-329	2856
XL88-171	US77-017	CP80-329	3338
XL88-380	CP65-357	CP80-352	88
XL88-381	CP74-383	CP80-352	53
XL88-393	CP80-352	CP80-352	89
XL88-430	CP61-037	CP80-356	68
XL88-431	CP72-370	CP80-356	144
XL88-423	CP80-328	CP80-356	496
XL88-428	CP80-356	CP80-356	660
XL88-424	CP83-606	CP80-356	16
XL88-058	CP80-352	CP81-332	1221
XL88-069	CP81-332	CP81-332	216
XL88-040	CP81-332	CP81-332	632
XL88-029	CP82-550	CP81-332	3321
XL88-057	CP83-606	CP81-332	0
XL88-161	CP65-357	CP82-519	336
XL88-162	CP75-361	CP82-519	252
XL88-168	CP82-519	CP82-519	173
XL88-125	CP65-357	CP82-550	184
XL88-144	CP74-383	CP82-550	162
XL88-137	CP82-550	CP82-550	130
XL88-126	LCP85-316	CP82-550	65
XL88-413	CP83-149	CP83-149	608
XL88-408	CP76-351	CP83-607	1307
XL88-415	CP83-607	CP83-607	0
XL88-261	CP61-037	CP84-722	689
XL88-260	CP79-332	CP84-722	1342
XL88-275	CP84-722	CP84-722	367
XL88-084	CP83-606	CP84-746	39

TABLE 5. 1988 CROSSING DATA SORTED BY MALE PARENT.

CROSS	FEMALE	MALE	SEED
XL88-095	CP84-746	CP84-746	9
XL88-296	CP76-351	CP84-755	630
XL88-303	CP77-310	CP84-755	33
XL88-295	CP79-318	CP84-755	130
XL88-299	CP84-755	CP84-755	16
XL88-186	CP77-310	CP84-761	4910
XL88-207	CP84-761	CP84-761	694
XL88-187	LCP81-005	CP84-761	1297
XL88-235	CP84-772	CP84-772	343
XL88-230	LCP85-307	CP84-772	2330
XL88-454	CP85-860	CP85-860	0
XL88-458	B70-734	CP86-915	0
XL88-461	B70-734	CP86-915	39
XL88-459	CP70-330	CP86-915	0
XL88-462	CP70-330	CP86-915	0
XL88-468	CP70-330	CP86-915	29
XL88-463	CP86-915	CP86-915	0
XL88-457	LCP86-458	CP86-915	0
XL88-469	LCP86-458	CP86-915	0
XL88-460	LCP86-458	CP86-915	18
XL88-456	CP86-962	CP86-962	.
XL88-353	CP72-1210	L75-002	819
XL88-286	CP72-370	L75-002	367
XL88-377	CP72-370	L75-002	1170
XL88-400	CP74-383	L75-002	1033
XL88-199	CP75-361	L75-002	2832
XL88-287	CP83-606	L75-002	18
XL88-213	L75-002	L75-002	95
XL88-245	LCP85-352	L75-002	497
XL88-010	CP74-383	L75-056	12
XL88-008	CP74-383	L75-056	324
XL88-013	CP74-383	L75-056	408
XL88-009	CP79-348	L75-056	291
XL88-011	CP79-348	L75-056	485
XL88-012	CP80-328	L75-056	376
XL88-014	CP80-328	L75-056	1566
XL88-037	L75-056	L75-056	29
XL88-336	CP67-412	L77-038	558
XL88-291	CP75-361	L77-038	934
XL88-298	L77-038	L77-038	106
XL88-005	CP71-1194	L78-035	1094
XL88-031	CP74-383	L78-035	0
XL88-006	CP81-316	L78-035	1011
XL88-099	L78-035	L78-035	18
XL88-035	L78-035	L78-035	740
XL88-200	CP72-1210	L83-193	95
XL88-214	L83-193	L83-193	60
XL88-270	CP78-357	L84-273	835
XL88-277	L84-273	L84-273	21
XL88-294	CP48-103	L84-275	1529
XL88-229	CP61-037	L84-275	600
XL88-234	L84-275	L84-275	0
XL88-244	CP80-323	L84-276	741
XL88-250	L84-276	L84-276	683
XL88-236	CP61-037	L84-290	632
XL88-340	CP65-357	L84-290	2243
XL88-091	CP74-383	L84-290	1229
XL88-308	CP75-361	L84-290	6945
XL88-341	CP79-318	L84-290	3552
XL88-222	CP79-332	L84-290	1714
XL88-132	CP80-328	L84-290	3654
XL88-223	CP80-352	L84-290	1735
XL88-098	L84-290	L84-290	.
XL88-052	CP72-356	LCP81-010	26
XL88-364	CP72-370	LCP81-010	1133
XL88-073	CP74-383	LCP81-010	8
XL88-075	CP74-383	LCP81-010	19
XL88-077	CP74-383	LCP81-010	99
XL88-053	CP75-361	LCP81-010	49
XL88-378	CP76-351	LCP81-010	1742
XL88-379	CP78-357	LCP81-010	2888
XL88-402	CP82-551	LCP81-010	450
XL88-067	LCP81-010	LCP81-010	52
XL88-159	LCP81-015	LCP81-010	202
XL88-074	LCP85-384	LCP81-010	56
XL88-072	LCP85-384	LCP81-010	68
XL88-076	LCP85-384	LCP81-010	209
XL88-170	CP48-103	LCP81-030	1635
XL88-420	CP65-357	LCP81-030	1443
XL88-160	CP70-330	LCP81-030	837
XL88-078	CP74-383	LCP81-030	1104
XL88-419	CP77-310	LCP81-030	1680
XL88-218	CP79-332	LCP81-030	2916
XL88-169	CP79-348	LCP81-030	1740
XL88-079	CP80-313	LCP81-030	1067
XL88-216	CP82-513	LCP81-030	730
XL88-115	L84-276	LCP81-030	2090
XL88-080	LCP81-005	LCP81-030	1334
XL88-217	LCP81-010	LCP81-030	1579
XL88-092	LCP81-030	LCP81-030	103
XL88-361	CP72-1210	LCP82-046	245
XL88-119	CP73-345	LCP82-046	902
XL88-362	CP77-310	LCP82-046	648
XL88-371	CP82-550	LCP82-046	.
XL88-081	L78-035	LCP82-046	442
XL88-094	LCP82-046	LCP82-046	0
XL88-120	LCP86-391	LCP82-046	683
XL88-088	CP70-330	LCP82-047	2408
XL88-358	CP72-1210	LCP82-047	1160
XL88-357	CP72-370	LCP82-047	1032

TABLE 5. 1988 CROSSING DATA SORTED BY MALE PARENT.

CROSS	FEMALE	MALE	SEED
XL88-131	CP73-345	LCP82-047	5465
XL88-304	CP80-323	LCP82-047	5055
XL88-305	CP84-730	LCP82-047	3878
XL88-096	LCP82-047	LCP82-047	1820
XL88-306	US77-017	LCP82-047	3630
XL88-390	CP70-330	LCP82-058	441
XL88-391	CP73-345	LCP82-058	1030
XL88-394	LCP82-058	LCP82-058	58
XL88-185	CP74-383	LCP82-089	2107
XL88-288	CP78-304	LCP82-089	1975
XL88-183	CP79-318	LCP82-089	4134
XL88-184	CP83-644	LCP82-089	5734
XL88-182	LCP81-010	LCP82-089	4450
XL88-289	LCP81-030	LCP82-089	2808
XL88-206	LCP82-089	LCP82-089	1173
XL88-418	CP72-370	LCP83-149	582
XL88-395	CP74-1094	LCP83-149	725
XL88-417	CP80-328	LCP83-149	767
XL88-396	CP80-329	LCP83-149	405
XL88-374	CP69-373	LCP83-179	81
XL88-343	CP72-370	LCP83-179	484
XL88-347	LCP83-179	LCP83-179	34
XL88-434	CP76-351	LCP84-215	990
XL88-342	CP77-310	LCP84-215	278
XL88-427	CP80-323	LCP84-215	955
XL88-346	LCP84-215	LCP84-215	.
XL88-149	CP79-318	LCP84-222	1947
XL88-153	LCP84-222	LCP84-222	252
XL88-405	CP69-373	LCP84-257	12
XL88-414	LCP84-257	LCP84-257	23
XL88-318	CP79-318	LCP85-298	561
XL88-243	CP82-550	LCP85-298	748
XL88-321	LCP85-298	LCP85-298	136
XL88-249	LCP85-298	LCP85-298	2116
XL88-106	CP65-357	LCP85-336	533
XL88-110	CP65-357	LCP85-336	1175
XL88-108	CP65-357	LCP85-336	1862
XL88-355	CP72-1210	LCP85-336	0
XL88-062	CP72-356	LCP85-336	1912
XL88-376	CP73-351	LCP85-336	1736
XL88-063	CP74-383	LCP85-336	3237
XL88-197	CP75-327	LCP85-336	2575
XL88-315	CP75-361	LCP85-336	3717
XL88-107	CP79-318	LCP85-336	783
XL88-111	CP79-318	LCP85-336	1045
XL88-109	CP79-318	LCP85-336	4288
XL88-064	LCP85-313	LCP85-336	1043
XL88-071	LCP85-336	LCP85-336	1804
XL88-061	LCP85-384	LCP85-336	5002
XL88-268	CP75-327	LCP85-384	1008
XL88-267	CP79-348	LCP85-384	722
XL88-276	LCP85-384	LCP85-384	209
XL88-453	LCP86-416	LCP86-416	12
XL88-465	B70-734	LCP86-456	8
XL88-467	B70-734	LCP86-456	70
XL88-466	LCP86-429	LCP86-456	102
XL88-464	LCP86-429	LCP86-456	120
XL88-470	LCP86-456	LCP86-456	0
XL88-028	CP83-607	US77-009	29
XL88-024	CP83-607	US77-009	713
XL88-027	CP84-746	US77-009	20
XL88-025	CP84-746	US77-009	22
XL88-026	CP84-746	US77-009	88
XL88-039	US77-009	US77-009	810
XL88-455	US77-012	US77-012	20
XL88-451	CP81-1435	US77-026	1411
XL88-449	CP81-1435	US78-026	493
XL88-450	CP81-1435	US78-026	2277
XL88-452	US78-026	US78-026	218
			======
			477084

1988 Selections, Line Trials, and Assignments

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During the summer of 1988, there were 126,971 experimental sugarcane varieties in the single stool through assignment stages of the Louisiana, "L", Sugarcane Variety Improvement Program. Through selection and line trial evaluations, 75,750 potential varieties remained by season's end (Table 1).

Eighty-four thousand seedlings, representing 233 crosses, were potted and placed in the greenhouse facility at the St. Gabriel Research Station in February. These crosses included the experimental crosses made in 1987 and proven crosses from the 1986 through the 1983 crossing series. In April, 71,507 single stools were established in the field.

There were 50,363 stubble single stools available for selection in 1988. Of these, 3,257 (7%) met or exceeded minimum standards for growth habit, stalk number, stalk diameter, stalk height, Brix (by hand refractometer) and pith and/or tube. These were planted in six-foot first line trial plots.

Six hundred sixteen clones from the 1985 crossing series were advanced and planted into single row, 16-foot long second line trial plots. Three hundred three clones from the 1984 crossing series were planted in increase plots and will be considered for assignment in 1988.

Based on agronomic ratings, stalk counts and three years of sucrose data, 67 clones were assigned permanent numbers in 1988. There were 55 "L88" designations assigned along with 12 "LCP88's" (Table 2). The "LCP" assignments were from crosses made at USDA facilities either at Houma, LA or Canal Point, FL with the subsequent selections and advancements being made at LAES facilities at St. Gabriel.

Crosses are evaluated on the percent of their progeny that advance through the selection stages to the assignment stage five years after crossing (Tables 3, 4, 5, and 6). Crossing and planting decisions are primarily based upon the percentile ranking (RANKS) or the percent advancement from the number of originally established seedlings (SURVIVE) to the most advanced stage of selection. This statistic is also used to evaluate parents. This latter utility is a crude empirical estimate of general combining ability.

Table 1. Summary of selections, advancements and assignments made during 1988 by the Louisiana, "L", Sugarcane Variety Improvement Program.

CROSSING SERIES	NUMBER OF CROSSES	SEEDLINGS POTTED	SEEDLINGS TO FIELD	SURVIVED TRANS-PLANTING	AVAILABLE FOR SELECTION	ADVANCED TO FIRST LINES	ADVANCED TO SECOND LINES	CANDIDATES FOR ASSIGNMENT	ASSIGNED IN 1988
83	194	80,000	67,167	54,756	37,967	3,816	926	264	67*
84	181	84,000	77,127	70,764	58,860	4,684	1,328	303*	
85	219	84,000	77,000	73,620	64,094	3,582	616*		
86	236	84,000	70,310	65,712	50,363*	3,257*			
87	233	84,000*	73,868*	71,507*					

* Work performed in 1988

Table 2. Summary of the data on the varieties assigned permanent numbers in 1988.*

VARIETY	PARENTS FEMALE	PARENTS MALE	STALK WEIGHT (lbs)	STALK NUMBER (#/A)	CANE YIELD (T/A)	SUGAR CONC. (lbs/T)	SUGAR YIELD (lbs/A)
CP61-037			2.17	24181	25.0	208	4546
CP65-357			2.22			271	
CP70-321			2.16	25862	29.7	239	5964
CP74-383			2.08	29606	32.6	215	5691
L88-026	CP65-357	CP77-402	2.39	28131	34.0	254	7888
L88-027	CP65-357	CP69-373	2.74	32668	46.2	216	8818
L88-028	CP70-300	CP72-355	2.35	43330	49.7	246	10540
L88-029	CP75-327	CP67-412	2.11	38113	40.9	220	7419
L88-030	CP65-357	CP77-402	2.07	38339	39.2	244	7851
L88-031	US77-017	CP70-321	2.84	30399	44.7	218	8817
L88-032	CP72-370	CP70-321	2.01	41289	39.2	246	8634
L88-033	CP79-332	CP72-370	1.95	38566	36.2	224	7130
L88-034	CP65-357	CP77-402	2.33	28585	35.8	240	7843
L88-035	MISC		2.07	30399	33.0	247	7158
L88-036	CP65-357	LCP81-030	2.44	29492	39.0	245	8660
L88-037	CP65-357	CP77-402	2.18	29945	34.4	247	7517
L88-038	CP65-357	LCP81-030	2.40	33802	41.8	251	9341
L88-039	CP79-332	CP72-370	1.89	33121	29.8	230	6197
L88-040	CP65-357	LCP81-030	1.81	34256	30.7	248	6424
L88-041	CP77-310	CP62-258	2.06	35617	37.9	236	7548
L88-042	CP61-037	CP78-304	2.16	34936	34.0	258	8162
L88-043	CP78-317	CP77-310	1.74	35164	30.4	244	7124
L88-044	CP70-321	CP75-308	2.38	29265	33.3	236	6811
L88-045	CP78-317	CP77-310	2.02	31760	31.0	234	6478
L88-046	CP74-383	CP70-321	2.08	36751	35.0	231	7067
L88-047	CP72-370	L75-002	2.22	28131	34.0	234	7036
L88-048	CP72-370	L75-002	2.25	24274	26.0	238	5942
L88-049	CP72-370	L75-002	2.42	28811	33.8	249	7535
L88-050	CP79-332	CP67-412	2.25	35844	37.3	249	8124
L88-051	CP72-370	CP80-329	2.33	34256	39.6	228	8033
L88-052	CP74-383	CP70-321	2.86	23593	32.0	233	6723
L88-053	CP74-383	CP70-321	2.21	28584	30.3	231	5964
L88-054	CP72-370	L75-002	2.36	27223	30.1	233	6435
L88-055	CP72-370	L75-002	2.40	27450	34.0	236	7294
LCP88-056	US79-010	CP70-1133	2.32	29946	34.1	223	6768
LCP88-057	US79-010	CP70-1133	2.50	31080	39.0	209	6863
LCP88-058	L75-035	US80-003	2.23	47868	48.1	211	8839
L88-059	CP74-383	LCP81-030	1.52	43784	34.5	245	7525
L88-060	CP78-317	CP76-301	2.72	38113	51.8	238	10823
L88-061	CP74-383	CP70-321	2.21	33122	37.9	237	7943
L88-062	CP80-352	CP72-355	1.70	36978	32.3	222	6708
L88-063	CP70-321	CP75-308	2.14	40381	43.1	222	8367
L88-064	CP50-028	CP78-304	3.00	24501	35.2	238	7877
L88-065	CP78-304	CP78-304	2.53	30172	34.7	211	6302
L88-066	CP65-357	CP70-321	2.03	35390	35.5	235	7399

Table 2 continued

VARIETY	PARENTS FEMALE	PARENTS MALE	STALK WEIGHT (lbs)	STALK NUMBER (#/A)	CANE YIELD (T/A)	SUGAR CONC. (lbs/T)	SUGAR YIELD (lbs/A)
L88-067	CP73-375	L75-002	2.25	30172	34.0	233	7210
L88-068	CP74-383	CP70-321	2.74	38112	52.2	204	9593
L88-069	LCP81-010	L80-045	2.67	33348	45.6	224	9032
L88-070	CP73-375	CP66-346	2.68	33348	42.9	226	8362
L88-071	L79-012	CP62-258	2.38	32441	41.6	208	8095
L88-072	CP79-332	CP77-310	2.20	40155	45.5	260	10783
L88-073	CP78-317	CP76-301	1.89	41516	38.1	241	8664
L88-074	CP70-330	CP67-412	1.96	34709	32.4	232	6277
L88-075	CP76-301	CP76-301	2.35	38340	42.9	228	8459
L88-076	CP79-311	CP76-301	2.31	37432	40.5	214	7395
LCP88-077	US80-004	CP72-355	2.53	27904	38.6	207	7181
LCP88-078	CP79-302	CP80-323	2.48	31307	37.7	214	7364
LCP88-079	CP74-383	CP80-323	2.48	30399	40.5	242	9030
L88-080	CP72-370	CP62-258	2.60	31533	37.4	235	7933
LCP88-081	CP79-302	CP80-323	1.83	41515	39.8	230	8209
L88-082	CP67-412	POLYCROSS	1.91	42423	42.4	227	8858
L88-083	CP72-370	CP62-258	1.82	36298	33.5	239	7085
L88-084	CP70-330	CP78-321	1.94	34256	32.7	238	7357
LCP88-085	CP79-302	CP80-323	2.41	26316	32.0	239	6778
L88-086	CP70-330	CP72-1312	2.44	28131	34.6	229	7312
LCP88-087	CP79-302	CP80-323	2.04	24047	22.6	244	4692
L88-088	CP72-370	CP62-258	2.17	37205	39.1	218	7373
LCP88-090	CP79-302	CP80-323	2.23	30399	31.6	267	7737
LCP88-091	CP79-318	CP80-323	2.58	33122	44.1	235	9303
L88-092	CP79-311	CP76-301	2.75	25182	35.3	231	7193
LCP88-093	CP70-330	CP77-310	2.70	26769	35.6	239	7639

* Varieties assigned "L88" numbers were from crosses made, selected and advanced by LSU personnel. Those assigned "LCP88" numbers were from crosses made at Canal Point, FL but selected and advanced at LSU.

Table 3. List of crosses of the 1983 crossing series and the percent advancement of their progenies through assignment in 1988.

CROSS	FEMALE	MALE	SURVIVE	SOWN	LINE1	R* ANK S1	LINE2	R* ANK S2	INCI	R* ANK S I	ASGN O	R* ANK A
MISC			.	.	6	.	6	.	1	.	1	.
XL83-0067	CP43-064	CP57-614	398	209	18	32	0	9	0	21	.	.
XL83-0155	CP43-064	CP70-321	218	108	16	60	1	22	0	21	.	.
XL83-0048	CP43-064	CP76-331	198	156	8	27	1	22	1	67	.	.
XL83-0157	CP48-103	CP77-310	1032	691	56	41	5	22	3	48	.	.
XL83-0164	CP50-028	CP77-310	226	146	10	31	1	20	0	21	.	.
XL83-0153	CP50-028	CP78-304	402	296	62	94	22	96	4	87	1	27
XL83-0046	CP52-068	CP62-258	228	149	14	49	4	64	1	59	.	.
XL83-0211	CP52-068	LCP81-030	117	101	31	99	2	62	2	95	.	.
XL83-0008	CP57-614	CP57-614	23	11	4	96	4	99	0	21	.	.
XL83-0040	CP57-614	L83P2	216	111	8	23	0	9	0	21	.	.
XL83-0132	CP61-037	CP57-614	420	265	14	20	1	18	0	21	.	.
XL83-0139	CP61-037	CP70-321	701	465	28	27	4	24	1	44	.	.
XL83-0151	CP61-037	CP78-304	787	588	73	78	14	64	5	74	1	9
XL83-0133	CP61-039	CP57-614	434	299	18	28	5	48	1	45	.	.
XL83-0191	CP61-039	CP72-355	205	162	5	14	0	9	0	21	.	.
XL83-0038	CP62-258	CP62-258	95	51	5	40	1	44	0	21	.	.
XL83-0097	CP65-357	CP69-373	539	410	37	56	13	76	5	85	1	16
XL83-0068	CP65-357	CP70-321	430	301	24	43	6	55	2	65	1	23
XL83-0108	CP65-357	CP77-402	1003	903	101	82	20	68	9	83	4	44
XL83-0212	CP65-357	LCP81-030	417	308	65	94	9	72	3	75	3	79
XL83-0220	CP65-357	L78-063	453	324	22	36	1	18	0	21	.	.
XL83-0195	CP65-357	L79-018	224	186	4	12	3	52	1	62	.	.
XX83-3077	CP65-357	US80-9	139	119	5	22	3	72	0	21	.	.
XL83-0066	CP66-346	CP66-346	232	147	4	11	1	20	0	21	.	.
XL83-0037	CP67-412	CP67-412	78	38	1	8	0	9	0	21	.	.
XL83-0039	CP67-412	L83P2	244	165	12	36	5	68	1	53	1	47
XL83-0026	CP70-300	CP67-412	455	179	6	8	0	9	0	21	.	.
XL83-0089	CP70-300	CP72-355	678	400	40	46	7	38	2	48	1	13
XL83-0019	CP70-300	CP75-1091	202	90	2	7	0	9	0	21	.	.
XL83-0017	CP70-300	US77-010	190	125	7	23	2	44	1	69	.	.
XL83-0084	CP70-310	CP57-614	220	120	14	51	1	22	1	62	.	.
XL83-0126	CP70-310	CP72-355	240	180	15	51	5	70	1	55	.	.
XL83-0106	CP70-310	CP76-301	296	200	7	14	2	27	0	21	.	.
XL83-0124	CP70-321	CP62-258	245	143	11	32	4	60	1	53	.	.
XL83-0053	CP70-321	CP67-412	91	57	6	53	2	72	0	21	.	.
XL83-0138	CP70-321	CP75-308	757	389	49	52	12	60	4	69	2	30
XL83-0143	CP70-321	CP77-402	72	55	3	30	0	9	0	21	.	.
XL83-0027	CP70-330	CP62-258	213	124	8	24	0	9	0	21	.	.
XL83-0047	CP70-330	CP67-412	221	158	12	41	3	55	1	62	1	62

Table 3 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LINE1NO	R* ANKS1	LINE2NO	R* ANKS2	INCNO	R* ANKSI	ASGNNO	R* ANKSA
XL83-0018	CP70-330	CP72-1210	87	35	3	21	1	44	0	21	.	.
XL83-0016	CP70-330	CP72-1312	200	121	14	57	2	38	1	66	1	69
XL83-0020	CP70-330	CP75-1091	128	52	7	42	2	60	1	77	.	.
XCP83-0965	CP70-330	CP76-331	459	313	24	39	9	68	0	21	.	.
XCP83-0529	CP70-330	CP77-310	338	150	24	58	6	64	1	48	1	34
XL83-0099	CP70-330	CP78-321	238	160	9	24	3	52	2	79	1	52
XX83-3085	CP70-330	US80-8	228	131	14	49	3	52	2	81	.	.
XL83-0115	CP71-1086	L65-069	501	305	33	53	6	48	2	51	.	.
XL83-0118	CP71-1194	CP62-258	438	268	43	81	10	75	2	64	.	.
XL83-0135	CP71-1194	CP72-355	265	177	37	91	6	75	1	50	.	.
XL83-0128	CP71-1194	L65-069	474	257	24	38	4	31	1	44	.	.
XL83-0150	CP71-1240	CP71-1240	212	79	1	5	0	9	0	21	.	.
XL83-0136	CP71-1240	CP72-355	406	203	27	55	8	68	4	86	.	.
XL83-0073	CP71-380	CP66-346	45	24	4	74	0	9	0	21	.	.
XL83-0090	CP71-380	CP72-355	87	58	8	78	1	44	0	21	.	.
XL83-0180	CP71-380	CP77-310	197	143	16	67	2	38	1	67	.	.
XL83-0141	CP71-380	CP77-402	92	80	17	97	2	72	1	89	.	.
XL83-0114	CP71-380	L65-069	156	96	8	38	2	52	0	21	.	.
XL83-0031	CP72-1210	L83P2	177	95	10	43	2	44	0	21	.	.
XL83-0085	CP72-1312	CP57-614	100	68	16	95	1	38	0	21	.	.
XL83-0025	CP72-1312	CP72-370	16	11	0	2	0	9	.	.	.	.
XL83-0123	CP72-1312	L65-069	651	500	38	45	10	57	0	21	.	.
XL83-0127	CP72-355	CP67-412	483	353	4	6	1	18	0	21	.	.
XL83-0134	CP72-370	CP62-258	862	559	120	90	57	97	23	97	3	39
XL83-0078	CP72-370	CP67-412	61	46	2	20	2	85	0	21	.	.
XL83-0042	CP72-370	CP70-321	143	97	14	81	8	96	1	75	1	76
XL83-0102	CP72-370	CP70-321	119	83	6	37	2	62	0	21	.	.
XL83-0022	CP72-370	CP72-1210	82	63	12	91	7	98	0	21	.	.
XL83-0009	CP72-370	CP76-331	186	153	17	76	4	72	0	21	.	.
XL83-0228	CP72-370	CP80-315	74	67	6	67	4	95	2	98	.	.
XL83-0224	CP72-370	CP80-329	903	683	79	72	28	83	8	82	1	4
XL83-0116	CP72-370	L65-069	511	327	41	66	13	77	2	51	.	.
XL83-0107	CP72-370	L75-002	518	414	64	87	12	75	8	94	5	95
XL83-0168	CP72-370	L80-045	169	111	39	98	6	87	0	21	.	.
XL83-0029	CP72-370	L83P2	247	181	21	71	3	48	0	21	.	.
XL83-0003	CP73-1547	CP76-331	82	54	3	23	1	48	0	21	.	.
XL83-0061	CP73-375	CP66-346	137	88	2	10	1	27	1	76	1	81
XL83-0113	CP73-375	L75-002	89	73	8	75	1	44	0	21	.	.
XL83-0130	CP73-375	L75-002	225	149	6	15	1	20	1	59	1	60
XL83-0043	CP74-1263	CP70-321	145	124	20	90	0	9	0	21	.	.
XL83-0062	CP74-328	CP57-614	82	46	8	81	1	48	0	21	.	.
XL83-0083	CP74-383	CP57-614	218	129	16	60	2	34	0	21	.	.

Table 3 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LINE1	R*ANKS1	LINE2	R*ANKS2	INCNO	R*ANKSI	ASGNO	R*ANKSA
XL83-0054	CP74-383	CP67-412	237	180	11	33	2	31	1	55	.	.
XL83-0093	CP74-383	CP69-373	410	283	17	28	4	38	0	21	.	.
XL83-0140	CP74-383	CP70-321	1222	875	95	65	34	81	9	76	5	47
XL83-0119	CP74-383	CP72-355	583	444	90	94	12	70	0	21	.	.
XL83-0208	CP74-383	CP76-301	1322	965	72	41	20	57	5	50	.	.
XCP83-0503	CP74-383	CP78-338	229	186	9	25	2	34	1	59	.	.
XCP83-0501	CP74-383	CP79-327	344	223	25	60	5	57	0	21	.	.
XCP83-0502	CP74-383	CP80-323	731	570	43	46	14	66	2	47	1	11
XL83-0218	CP74-383	LCP81-030	235	192	20	71	6	78	1	57	1	56
XL83-0206	CP74-383	L79-018	64	46	4	51	2	83	0	21	.	.
XL83-0186	CP74-383	L80-043	240	162	0	2	0	9	.	.	.	.
XCP83-0545	CP74-387	CP80-323	222	145	39	96	6	80	1	62	.	.
XL83-0013	CP75-1082	CP75-1082	22	15	2	76	1	92	1	99	.	.
XL83-0012	CP75-1091	CP75-1091	115	36	0	2	0	9	.	.	.	.
XL83-0030	CP75-1091	L83P2	229	152	21	78	2	34	1	59	.	.
XL83-0146	CP75-308	CP75-308	99	51	3	18	0	9	0	21	.	.
XL83-0063	CP75-327	CP57-614	74	43	1	9	0	9	0	21	.	.
XL83-0120	CP75-327	CP67-412	802	490	32	27	7	34	3	49	1	6
XL83-0094	CP75-327	CP69-373	98	46	8	69	4	90	1	87	.	.
XL83-0129	CP75-327	CP77-402	929	773	56	47	15	60	7	77	.	.
XL83-0109	CP76-301	CP76-301	230	135	12	39	3	52	2	80	1	56
XL83-0010	CP76-331	CP76-331	56	21	0	2	0	9	.	.	.	.
XL83-0001	CP76-331	L83P1	233	158	7	18	0	9	0	21	.	.
XL83-0144	CP76-340	CP70-321	202	139	8	27	2	38	0	21	.	.
XL83-0149	CP76-340	CP71-1240	217	160	15	56	0	9	0	21	.	.
XL83-0076	CP76-340	CP72-370	117	92	3	15	1	34	0	21	.	.
XL83-0071	CP77-310	CP62-258	341	227	35	83	13	88	2	71	1	32
XL83-0110	CP77-310	CP77-310	43	16	2	34	0	9	0	21	.	.
XCP83-0548	CP77-310	CP80-323	202	143	12	46	4	68	2	86	.	.
XL83-0112	CP77-402	CP77-402	100	62	0	2	0	9	.	.	.	.
XL83-0175	CP78-304	CP72-355	221	190	8	22	2	34	0	21	.	.
XL83-0166	CP78-304	CP77-310	1056	743	64	49	12	44	5	65	.	.
XL83-0154	CP78-304	CP78-304	121	92	13	84	3	77	1	78	1	83
XL83-0086	CP78-310	CP57-614	245	202	19	65	3	48	1	53	.	.
XL83-0058	CP78-310	CP62-258	97	73	6	50	1	38	0	21	.	.
XL83-0011	CP78-310	CP75-1091	37	30	3	67	1	80	0	21	.	.
XL83-0104	CP78-317	CP76-301	221	177	22	82	8	87	6	98	2	90
XL83-0162	CP78-317	CP77-310	615	498	68	86	13	70	7	90	2	37
XL83-0065	CP78-321	CP78-321	65	60	0	2	0	9	.	.	.	.
XL83-0070	CP79-301	CP62-258	262	192	28	84	5	66	3	90	.	.
XCP83-0525	CP79-301	CP68-1026	124	95	19	93	1	31	0	21	.	.
XL83-0096	CP79-301	CP69-373	163	143	18	85	5	83	1	73	.	.

Table 3 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LINE1	R* RANKS1	LINE2	R* RANKS2	INCROSS	R* RANKSI	ASGNO	R* RANKSA
XCP83-0486	CP79-301	CP80-323	216	174	33	93	18	98	1	64	.	.
XCP83-0489	CP79-301	CP80-346	230	171	19	70	9	88	2	80	.	.
XCP83-0495	CP79-302	CP80-323	216	191	23	83	10	93	5	97	3	97
XCP83-0950	CP79-302	CP80-323	211	172	17	67	7	85	3	93	2	93
XL83-0105	CP79-311	CP76-301	239	188	26	85	7	82	5	96	2	86
XL83-0163	CP79-311	CP77-310	142	94	11	64	1	27	0	21	.	.
XL83-0219	CP79-311	LCP81-030	198	159	22	86	5	77	1	67	.	.
XL83-0072	CP79-318	CP62-258	166	114	8	35	1	24	1	72	.	.
XL83-0060	CP79-318	CP66-346	364	294	22	47	5	55	1	47	.	.
XL83-0137	CP79-318	CP72-355	1705	1001	114	55	19	44	2	43	.	.
XL83-0075	CP79-318	CP72-370	106	80	5	34	0	9	0	21	.	.
XCP83-0513	CP79-318	CP78-304	150	99	24	95	7	93	3	95	.	.
XCP83-0510	CP79-318	CP80-323	209	111	27	88	11	94	1	66	1	67
XX83-3083	CP79-318	US80-8	231	175	27	87	9	88	2	80	.	.
XL83-0057	CP79-332	CP62-258	61	59	12	97	2	85	0	21	.	.
XL83-0069	CP79-332	CP67-412	484	394	27	43	4	31	2	53	1	18
XL83-0074	CP79-332	CP72-370	551	456	73	89	8	57	5	83	2	41
XCP83-0519	CP79-332	CP77-310	195	156	29	92	9	93	2	88	.	.
XL83-0159	CP79-332	CP77-310	421	359	37	73	5	48	5	91	1	25
XX83-3082	CP79-332	US80-11	148	98	19	88	8	95	3	96	.	.
XCP83-0521	CP79-348	CP74-387	229	164	17	62	2	34	1	59	.	.
XCP83-0558	CP80-313	CP80-323	231	168	19	69	3	52	1	57	.	.
XCP83-0540	CP80-315	CP78-338	205	171	15	60	3	57	0	21	.	.
XL83-0207	CP80-317	CP76-301	413	326	27	52	5	48	1	45	.	.
XL83-0217	CP80-320	LCP81-018	218	128	0	2	0	9	.	.	.	.
XL83-0214	CP80-325	CP77-310	202	145	4	13	2	38	0	21	.	.
XCP83-0534	CP80-346	CP79-327	155	105	14	75	4	78	2	91	.	.
XL83-0176	CP80-352	CP72-355	218	185	19	72	4	64	2	84	1	65
XL83-0177	CP80-352	CP77-310	118	89	5	30	0	9	0	21	.	.
XL83-0182	CP80-352	LCP81-018	397	294	17	31	3	31	1	46	.	.
XL83-0172	LCP81-010	CP77-310	170	118	8	34	3	64	0	21	.	.
XL83-0167	LCP81-010	L80-045	185	139	9	36	4	72	1	69	1	74
XL83-0117	L65-069	L65-069	95	49	13	89	7	97	1	88	.	.
XL83-0160	L75-002	CP77-310	77	57	7	76	0	9	0	21	.	.
XL83-0111	L75-002	L75-002	33	27	0	2	0	9	.	.	.	.
XL83-0221	L75-002	L78-063	77	51	3	25	0	9	0	21	.	.
XX83-3042	L75-035	US80-3	461	354	13	16	5	44	2	57	1	20
XL83-0204	L78-035	CP62-258	180	132	14	65	8	91	1	70	.	.
XL83-0209	L78-035	CP76-301	464	298	32	56	13	81	0	21	.	.
XL83-0199	L78-035	CP80-360	235	171	20	71	4	62	1	57	.	.
XL83-0236	L79-012	CP62-258	198	138	40	98	8	90	3	93	1	72
XL83-0173	L79-018	CP72-355	171	100	5	17	1	24	0	21	.	.

Table 3 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LINE1	R* RANKS1	LINE2	R* RANKS2	INCREASE	R* RANKSI	ASSGN	R* RANKSA
XL83-0185	L79-018	LCP81-026	224	171	8	22	5	72	1	62	.	.
XL83-0197	L79-018	L79-018	193	66	0	2	0	9	.	.	.	.
XL83-0189	L80-002	CP62-258	178	113	10	43	2	44	0	21	.	.
XL83-0190	L80-002	CP72-355	153	109	2	8	1	27	0	21	.	.
XL83-0196	L80-002	L80-045	331	209	19	45	2	24	0	21	.	.
XL83-0222	L80-035	L78-063	250	170	19	63	2	31	0	21	.	.
XL83-0187	L80-038	CP62-258	183	132	16	72	2	44	1	70	.	.
XL83-0203	L80-040	CP62-258	168	128	16	80	8	94	1	72	.	.
XL83-0198	L80-043	L80-043	175	77	3	11	0	9	0	21	.	.
XL83-0183	L80-045	LCP81-026	216	126	15	56	3	55	2	85	.	.
XL83-0171	L81-001	CP77-310	225	193	16	58	0	9	0	21	.	.
XL83-0210	L81-002	LCP81-018	186	147	3	10	0	9	0	21	.	.
XL83-0035	US77-010	US77-010	145	84	4	16	0	9	0	21	.	.
XL83-0145	US77-017	CP70-321	999	640	66	53	13	52	6	72	1	2
XL83-0103	US77-017	CP77-310	149	117	8	41	5	86	2	92	.	.
XL83-0181	US77-017	LCP81-018	209	171	6	17	2	38	0	21	.	.
XX83-3054	US77-11	CP70-1133	177	115	16	75	7	90	3	94	.	.
XX83-3079	US79-10	CP70-1133	228	211	17	63	6	78	2	81	2	88
XX83-3012	US79-13	CP70-1133	142	43	6	30	1	27	1	75	.	.
XX83-3055	US80-10	CP70-1133	240	148	8	20	2	31	1	55	.	.
XX83-3014	US80-2	CP79-318	241	212	2	6	2	31	1	53	.	.
XX83-3021	US80-23	CP62-258	145	107	1	5	0	9	0	21	.	.
XX83-3016	US80-23	CP72-355	122	83	3	14	2	60	0	21	.	.
XX83-3103	US80-24	CP79-327	94	76	7	62	4	91	1	89	.	.
XX83-3052	US80-27	CP70-1133	213	144	20	79	6	81	0	21	.	.
XX83-3089	US80-28	CP78-304	229	201	4	11	0	9	0	21	.	.
XX83-3018	US80-4	CP72-355	239	189	19	66	8	85	2	79	1	52
XX83-3053	US80-5	CP70-1133	242	151	18	62	1	20	0	21	.	.
XX83-3091	US80-9	CP78-304	140	100	2	9	1	27	0	21	.	.
SUM			54756	37967	3816		926		264		67	

* RANKS1, RANKS2, RANKSI, and RANKSA refer to percentile rank of each cross based on percent advancement from SURVIVE through LINE1, LINE2, INCREASE and ASSGN, respectively.

Table 4. List of crosses of the 1984 crossing series and the percent advancement of their progenies through the increase plot stage planted in 1988.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LINE1	R* ANKS 1	LINE2	R* ANKS 2	INCNO	R* ANKS I
XL84-MISC			.	.	2	.	1	.	1	.
XL84-0184			214	.	17	66	1	16	1	45
XL84-0221	CP48-103	CP62-258	1146	927	96	71	52	90	12	81
XL84-0018	CP48-103	CP67-411	863	591	57	57	10	41	5	58
XL84-0037	CP48-103	CP75-1082	386	293	24	53	5	45	1	14
XL83-0157	CP48-103	CP77-310	865	644	45	40	14	57	1	2
XL84-0032	CP48-103	CP77-310	441	315	20	32	6	50	3	64
XL84-0149	CP48-103	CP77-402	477	425	31	56	12	70	2	32
XL84-0250	CP52-068	CP62-258	251	187	16	55	4	57	1	26
XL84-0133	CP52-068	CP75-308	411	371	35	72	9	66	2	50
XL84-0190	CP52-068	L65-069	209	161	5	9	0	3	.	.
XL84-0054	CP53-018	CP77-310	425	311	30	60	13	79	2	45
XL84-0248	CP57-614	CP62-258	216	163	15	57	1	16	.	.
XL84-0163	CP61-037	CP73-351	156	127	13	69	2	45	1	62
XL84-0204	CP61-037	CP76-331	221	168	.	.	.	.	.	.
XL84-0297	CP61-037	L75-002	679	498	34	36	7	34	.	.
XL84-0247	CP61-039	CP66-346	475	409	15	15	4	25	1	7
XL84-0229	CP61-039	CP67-412	486	423	.	.	.	.	.	.
XL84-0185	CP61-039	CP72-2086	466	389	24	40	3	21	.	.
XL84-0207	CP61-039	CP80-319	496	394	.	.	.	.	.	.
XL84-0148	CP61-039	FLORIDAS	222	203	10	32	2	29	1	39
XL84-0214	CP61-039	L78-063	444	367	18	24	6	50	2	39
XL84-0270	CP65-357	CP72-2086	458	412	20	30	4	29	4	72
XL84-0150	CP65-357	CP77-402	440	386	17	20	2	16	.	.
XL84-0223	CP65-357	LCP81-030	654	572	68	87	22	83	8	82
XL84-0273	CP65-357	L65-069	242	207	5	5	1	12	.	.
XX84-3056	CP65-357	MANDALAY	249	231	.	.	.	.	.	.
XX84-3057	CP65-357	SES231	241	211	.	.	.	.	.	.
XX84-3026	CP65-357	US77-10	233	151	1	0	0	3	.	.
XX84-3012	CP65-357	US78-20	496	359	24	35	8	57	2	26
XL84-0274	CP66-346	CP57-614	216	141	3	3	0	3	.	.
XL84-0239	CP67-412	CP70-321	690	600	16	7	1	7	.	.
XL84-0265	CP67-412	L75-002	405	367	18	30	1	9	.	.
XX84-3059	CP68-413	US81-42	102	91	3	12	0	3	.	.
XL84-0228	CP69-373	CP67-412	206	156	39	98	14	98	2	78
XL84-0242	CP69-373	L78-063	216	183	5	7	0	3	.	.
XL84-0060	CP70-300	CP72-1312	193	146	8	24	2	34	1	53
XL84-0036	CP70-300	CP75-1082	399	313	21	42	9	67	1	12
XL84-0225	CP70-300	LCP81-030	705	557	67	79	13	61	4	56
XL84-0219	CP70-321	CP62-258	435	335	37	72	12	75	3	65
XL83-0047	CP70-330	CP67-412	209	148	15	61	8	87	3	89

Table 4 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LINE1	R*ANKS1	LINE2	R*ANKS2	INCNO	R*ANKSI
XL84-0022	CP70-330	CP72-356	444	360	45	84	16	85	6	84
XL84-0029	CP70-330	CP72-370	223	156	10	32	3	45	2	76
XL84-0047	CP70-330	CP76-331	612	410	43	59	11	61	1	4
XL84-0279	CP70-330	L75-002	1334	1094	93	59	19	50	5	24
XL84-0243	CP70-330	L78-063	855	716	32	17	8	29	2	11
XL84-0307	CP72-1210	L65-069	606	465	35	50	2	11	.	.
XL84-0280	CP72-2086	L75-002	997	775	80	67	19	63	9	76
XL84-0256	CP72-355	CP67-412	154	154	15	80	8	92	.	.
XL83-0161	CP72-355	CP77-310	263	191	26	82	4	54	.	.
XL84-0201	CP72-355	CP77-407	149	110	22	93	6	88	.	.
XL84-0202	CP72-355	LCP81-030	934	774	161	98	60	98	4	35
XL84-0041	CP72-356	CP57-614	626	460	38	52	10	57	.	.
XL84-0026	CP72-356	CP77-414	236	164	14	50	0	3	.	.
XL84-0251	CP72-370	CP62-258	474	419	75	96	30	97	11	95
XL84-0167	CP72-370	CP66-346	209	192	18	73	3	50	.	.
XL84-0194	CP72-370	L65-069	215	188	12	48	1	16	.	.
XL84-0294	CP72-370	L75-002	699	608	44	54	24	83	7	79
XX84-3049	CP72-370	US80-24	109	99	6	47	3	75	.	.
XL84-0249	CP73-345	CP62-258	448	380	44	81	21	91	8	93
XL84-0290	CP73-345	CP76-301	341	267	27	66	5	54	.	.
XL84-0281	CP73-345	CP77-402	661	591	33	36	6	29	2	19
XL84-0263	CP73-345	CP77-407	220	201	27	91	3	50	3	85
XL84-0283	CP73-345	LCP81-030	695	617	63	77	6	29	3	35
XL83-0113	CP73-375	L75-002	473	344	25	42	3	21	.	.
XL84-0045	CP74-2005	CP76-331	210	161	2	1	0	3	.	.
XL84-0055	CP74-2005	CP77-310	60	54	5	69	2	82	.	.
XL83-0054	CP74-383	CP67-412	258	232	10	20	3	41	2	69
XL84-0056	CP74-383	CP72-1312	244	196	19	64	6	70	.	.
XL84-0168	CP74-383	LCP81-030	1424	1167	127	74	13	29	6	32
XL84-0034	CP75-1322	CP77-310	444	360	31	59	11	70	3	64
XL84-0046	CP75-1632	CP76-331	67	30	2	13	0	3	.	.
XL84-0238	CP75-308	CP70-321	648	501	111	97	31	91	10	91
XL84-0179	CP75-360	CP76-331	570	428	22	20	5	29	1	5
XX84-3028	CP75-361	US77-10	241	203	25	87	4	59	1	28
XL84-0303	CP76-301	L65-069	173	157	.	.	.	.	.	.
XL84-0218	CP76-331	CP62-258	422	330	43	85	15	85	4	77
XX84-3001	CP76-331	US77-12	486	452	49	84	6	41	.	.
XL84-0277	CP76-351	CP70-321	140	117	6	29	4	76	1	68
XL84-0282	CP76-351	CP77-402	452	424	19	27	6	45	4	73
XL84-0284	CP76-351	LCP81-030	616	539	56	77	6	34	3	50
XL84-0007	CP77-1414	CP77-414	189	170	2	2	1	16	.	.
XX84-3011	CP77-310	US78-20	458	433	10	6	5	38	.	.

Table 4 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LINE1NO	R*ANKS1	LINE2NO	R*ANKS2	INCNO	R*ANKSI
XL84-0258	CP77-402	L65-069	574	511	29	38	18	79	4	67
XL84-0295	CP77-402	L75-002	1154	997	45	20	14	41	3	14
XL84-0157	CP77-405	CP76-331	281	205	26	78	6	65	.	.
XL84-0078	CP77-405	84P2	190	99	8	27	4	65	1	54
XL84-0241	CP77-411	L78-063	475	393	11	7	1	9	.	.
XL84-0289	CP77-416	CP76-301	125	88	5	22	4	81	.	.
XL84-0272	CP78-317	CP72-2086	236	203	17	61	4	59	2	71
XL84-0222	CP78-317	LCP81-030	699	637	105	94	44	97	12	92
XL84-0113	CP78-317	L78-063	165	163	15	77	7	89	1	60
XL84-0260	CP78-357	CP70-321	217	186	8	17	6	75	.	.
XL84-0198	CP78-357	CP73-351	219	193	10	34	3	50	1	43
XL84-0301	CP78-357	CP75-308	1097	982	50	34	28	72	9	70
XL84-0278	CP78-357	CP77-407	219	200	34	96	13	95	3	87
XL84-0213	CP78-357	L65-069	462	363	16	16	4	29	1	10
XL84-0264	CP78-357	L75-002	750	642	47	54	21	75	2	15
XL84-0052	CP79-302	LCP81-026	203	202	31	94	11	94	3	90
XL84-0079	CP79-302	84P2	422	344	42	83	13	79	6	88
XL84-0231	CP79-318	CP70-321	962	658	39	24	22	67	3	21
XL84-0271	CP79-318	CP72-2086	475	397	13	11	3	21	.	.
XX84-3029	CP79-318	US77-10	235	182	13	47	2	29	.	.
XX84-3045	CP79-318	US79-7	491	369	20	24	1	9	.	.
XX84-3047	CP79-318	US80-24	442	371	19	29	3	23	2	39
XL84-0299	CP79-332	CP75-308	482	437	61	92	15	79	2	28
XX84-3046	CP79-332	US79-7	467	414	25	44	6	45	1	7
XL84-0030	CP79-348	CP72-370	166	143	15	75	10	96	5	97
XL84-0006	CP79-348	CP77-414	242	226	6	10	1	12	.	.
XX84-3048	CP79-348	US80-24	173	161	7	22	6	84	1	58
XL84-0240	CP80-313	CP70-321	724	597	39	44	14	63	4	55
XL84-0287	CP80-313	CP76-301	155	119	9	50	1	21	.	.
XL84-0254	CP80-313	LCP81-030	704	577	92	93	37	93	13	94
XL84-0262	CP80-319	CP70-321	363	341	11	13	4	38	1	17
XL84-0285	CP80-319	CP76-301	183	166	.	.	.	.	.	.
XL84-0275	CP80-324	CP57-614	799	700	42	42	3	12	.	.
XL84-0072	CP80-324	CP70-321	93	66	6	56	0	3	.	.
XL84-0336	CP80-328	CP77-402	205	146	24	89	3	54	.	.
XL84-0203	CP80-329	LCP81-030	208	179	21	84	1	16	.	.
XL84-0130	CP80-352	CP75-308	392	362	20	38	5	45	2	52
XL84-0215	CP80-352	L78-063	185	172	6	15	1	16	.	.
XL84-0286	CP80-356	CP76-301	176	156	5	11	2	38	.	.
XL84-0268	CP80-356	CP78-304	475	411	52	88	13	73	3	61
XL84-0293	CP81-307	L75-002	932	847	39	27	2	9	.	.
XL84-0051	CP81-316	LCP81-026	243	179	24	82	3	41	1	28

Table 4 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LINE1	R*ANK1	LINE2	R*ANK2	INCNO	R*ANKI
XL84-0288	CP81-338	CP76-301	827	624	93	89	28	83	3	23
XL84-0226	CP81-338	LCP81-030	479	420	26	44	11	67	2	32
XL84-0217	LCP81-005	CP62-258	217	171	21	80	8	86	.	.
XL84-0232	LCP81-005	CP70-321	135	117	1	1	0	3	.	.
XL84-0224	LCP81-005	LCP81-030	239	204	25	88	9	87	6	96
XL84-0266	LCP81-005	L75-002	225	209	16	60	7	79	1	37
XL84-0310	LCP81-012	CP70-321	944	680	96	85	24	70	2	7
XL84-0308	LCP81-012	CP76-301	440	376	18	24	3	23	.	.
XL84-0305	LCP81-012	L65-069	81	68	19	99	11	99	3	98
XL84-0235	LCP81-015	CP70-321	954	774	50	40	9	29	1	1
XL84-0259	LCP81-015	L65-069	568	471	32	48	6	38	.	.
XL84-0230	LCP81-018	CP70-321	294	177	8	11	0	3	.	.
XL84-0267	LCP81-018	L75-002	619	450	38	52	3	16	.	.
XL84-0244	LCP81-023	L65-069	668	541	80	90	17	70	2	19
XL84-0402	LCP82-096	CP75-1082	389	278	21	44	1	11	.	.
XL83-0160	L75-002	CP77-310	565	470	47	69	18	81	5	73
XL84-0200	L75-056	CP66-346	197	183	7	16	3	54	.	.
XL84-0017	L75-056	84P1	215	107	11	38	1	16	.	.
XL84-0252	L77-038	CP62-258	200	181	15	62	2	34	.	.
XL84-0139	L77-038	CP66-346	373	367	34	77	6	57	.	.
XL84-0216	L78-035	CP62-258	440	362	24	47	12	73	2	39
XL84-0296	L78-063	L75-002	491	420	19	20	3	21	.	.
XL84-0058	L79-018	CP77-414	461	418	11	9	6	45	.	.
XL84-0023	L80-002	CP72-356	216	185	18	69	4	63	1	43
XL84-0044	L80-002	CP76-331	302	188	15	36	9	77	.	.
XL84-0033	L80-002	CP77-310	217	157	13	51	1	16	.	.
XL84-0233	L80-035	CP70-321	581	273	12	5	8	50	2	22
XL84-0169	L80-035	LCP81-030	669	512	103	95	35	92	7	81
XL84-0298	L80-35	L75-002	709	603	38	44	13	61	2	17
XL84-0021	L81-001	CP67-411	203	102	4	4	2	34	.	.
XL84-0039	L81-001	CP75-1082	209	147	4	3	2	34	1	47
XL84-0035	L81-001	CP77-310	476	404	37	64	20	89	2	32
XL84-0027	L81-001	CP77-414	731	582	33	32	6	25	1	3
XL84-0025	US77-1	CP77-414	68	50	6	74	1	54	.	.
XL84-0038	US77-10	CP75 1082	128	108	.	.	.	.	.	.
XL84-0016	US77-10	84P1	193	138	8	24	2	34	.	.
XL84-0011	US77-14	CP77-310	147	113	18	91	8	94	2	85
XL84-0234	US77-17	CP70-321	418	378	33	66	8	63	2	47
XL84-0300	US77-17	CP75-308	461	421	36	64	6	45	1	10
XL84-0193	US77-17	L65-069	412	359	34	69	10	68	2	50

Table 4 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LINE1	RANKS1*	LINE2	RANKS2*	INCNO	RANKSI*
XX84-3042	US79-11	CP78-304	515	459	44	72	6	41	3	58
XX84-3033	US81-2	CP81-338	250	208	8	15	2	25	.	.
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SUM			70764	56860	4684		1328		301	

* RANKS1, RANKS2, and RANKSI refer to percentile rank of each cross based on percent advancement from SURVIVE through LINE1, LINE2, and INCREASE, respectively.

Table 5. List of crosses of the 1985 crossing series and the percent advancement of their progenies through the second line trial stage planted in 1988.

CROSS	FEMALE	MALE	SURVIVE	SOWINTER	LINE1	R* ANKS 1	LINE2	R* ANKS 2
XL85-MISC			.	1161	87	.	16	.
XL85-0149	COLD TOL	LCP81-030	259	252	13	53	1	13
XL83-0155	CP43-064	CP70-321	875	690	32	33	5	28
XL85-0251	CP48-103	CP69-1052	186	137	7	35	2	57
XL85-0026	CP48-103	CP70-321	236	151	.	.	.	.
XL85-0045	CP48-103	CP76-331	189	165	12	69	5	93
XL85-0148	CP48-103	LCP81-030	453	405	18	39	5	57
XL83-0153	CP50-028	CP78-304	634	558	46	76	10	76
XL85-0050	CP52-068	CP75-308	417	379	20	49	4	51
XL85-0328	CP52-068	CP80-360	236	217	14	66	4	79
XL83-0211	CP52-068	LCP81-030	884	715	38	44	16	82
XL85-0021	CP52-068	LCP81-030	886	876	49	61	17	84
XL85-0317	CP52-068	L78-063	177	173	8	46	.	.
XL85-0018	CP57-614	CP57-614	108	86	1	2	.	.
XL85-0203	CP61-037	CP57-614	174	151	7	39	1	28
XL85-0109	CP61-037	CP70-321	243	235	6	16	.	.
XL85-0256	CP61-037	CP72-1312	257	175	13	54	1	13
XL85-0099	CP61-037	CP73-351	643	388	21	28	3	22
XL85-0144	CP61-037	CP76-301	217	210	7	26	1	22
XL85-0192	CP62-258	CP62-258	55	43	4	76	.	.
XL85-0196	CP65-357	CP62-258	215	186	14	72	3	69
XL85-0137	CP65-357	CP67-412	113	109	10	85	1	45
XL85-0223	CP65-357	CP69-1052	485	458	21	44	2	13
XL85-0124	CP65-357	CP69-373	144	142	11	80	1	34
XL85-0036	CP65-357	CP70-321	180	175	9	53	3	79
XL85-0103	CP65-357	CP72-2086	448	264	16	31	.	.
XL85-0103	CP65-357	CP72-2086	448	184	16	31	.	.
XL83-0212	CP65-357	LCP81-030	1704	1413	70	41	15	45
XL85-0173	CP67-412	CP67-412	55	43	4	76	.	.
XL85-0194	CP69-1052	CP69-1052	50	28	1	9	.	.
XL85-0138	CP70-300	CP67-412	117	98	7	67	.	.
XL85-0247	CP70-321	CP66-346	456	427	13	20	2	13
XL85-0172	CP70-321	CP67-412	181	176	11	68	3	79
XL85-0008	CP70-321	CP72-355	212	203	4	8	1	22
XL85-0098	CP70-321	CP73-351	485	471	20	41	8	76
XL85-0210	CP70-321	CP80-323	235	208	19	82	6	93
XL85-0270	CP70-330	CP66-346	193	163	4	10	.	.
XL85-0139	CP70-330	CP67-412	123	89	6	51	.	.
XL85-0252	CP70-330	CP69-1052	188	148	35	99	8	99

Table 5 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LINE1 NO	LINE1 R* ANKS 1	LINE2 NO	LINE2 R* ANKS 2
XL85-0024	CP70-330	CP72-355	642	597	37	64	3	22
XL85-0278	CP70-330	CP76-301	217	179	29	97	7	95
XL85-0044	CP70-330	CP76-331	233	203	17	76	5	88
XL85-0186	CP70-330	CP77-407	147	116	14	88	1	34
XL85-0209	CP70-330	CP80-323	217	175	8	33	2	45
XL85-0110	CP70-330	LCP81-030	566	457	28	51	4	34
XL85-0263	CP70-330	LCP82-089	230	180	6	17	1	13
XL85-0201	CP70-330	L75-002	768	632	30	37	2	5
XL83-0118	CP71-1194	CP62-258	930	659	33	30	6	28
XL83-0135	CP71-1194	CP72-355	1179	705	25	10	3	5
XL83-0136	CP71-1240	CP72-355	477	274	23	49	12	91
XL85-0239	CP71-357	CP67-412	230	174	10	44	3	64
XL83-0073	CP71-380	CP66-346	484	383	24	53	4	39
XL83-0141	CP71-380	CP77-402	169	161	2	4	.	.
XL85-0230	CP71-441	CP70-321	506	420	13	17	1	2
XL85-0259	CP71-441	CP76-301	233	210	26	93	2	45
XL85-0125	CP71-459	CP69-373	228	228	.	.	.	.
XL85-0101	CP71-459	CP72-2086	76	66	.	.	.	.
XL85-0084	CP72-1210	CP70-321	221	221	21	88	1	22
XL85-0114	CP72-1210	CP73-351	225	195	8	31	2	45
XL83-0085	CP72-1312	CP57-614	206	177	10	51	4	84
XL85-0035	CP72-1312	CP72-355	445	398	23	56	11	91
XL85-0167	CP72-2086	CP72-2086	55	35	3	61	1	82
XL83-0134	CP72-370	CP62-258	1237	940	57	48	9	34
XL85-0171	CP72-370	CP67-412	232	195	10	44	3	64
XL85-0097	CP72-370	CP73-351	440	411	23	56	4	45
XL85-0111	CP72-370	LCP81-030	1154	656	25	12	.	.
XL83-0116	CP72-370	L65-069	460	385	25	59	5	57
XL83-0029	CP72-370	L83P2	619	483	24	37	8	64
XL85-0206	CP73-345	CP73-351	140	117	7	53	.	.
XL85-0146	CP73-345	CP78-304	109	105	18	99	4	98
XL85-0146	CP73-345	CP78-304	125	105	18	97	4	95
XL85-0233	CP73-345	LCP81-030	227	192	7	24	1	13
XL83-0062	CP74-328	CP57-614	372	337	17	48	1	5
XL83-0083	CP74-383	CP57-614	428	425	24	62	3	34
XL85-0126	CP74-383	CP69-373	513	488	26	54	1	2
XL83-0140	CP74-383	CP70-321	1009	988	53	57	14	69
XL83-0119	CP74-383	CP72-355	599	437	6	3	.	.
XL85-0168	CP74-383	CP73-351	160	152	2	4	.	.
XL85-0001	CP74-383	CP74-2013	211	155	1	0	.	.
XL85-0022	CP74-383	LCP81-030	479	477	18	35	7	72
XL85-0058	CP74-383	LCP82-076	217	215	7	26	.	.

Table 5 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LIN1NO	R* ANKS 1	LIN2NO	R* ANKS 2
XL83-0013	CP75-1082	CP75-1082	157	113	1	0	.	.
XL85-0321	CP75-1091	CP78-304	256	139	4	6	.	.
XL83-0030	CP75-1091	L83P2	642	462	5	1	.	.
XL85-0253	CP75-308	CP69-1052	252	223	20	81	4	76
XL85-0132	CP75-308	CP70-321	751	590	20	19	1	0
XL85-0104	CP75-308	CP72-2086	104	103	7	73	.	.
XL85-0118	CP75-308	CP77-310	91	73	2	12	.	.
XL85-0156	CP76-331	85P2	444	363	5	3	.	.
XL83-0071	CP77-310	CP62-258	161	156	14	85	2	61
XL85-0059	CP77-310	LCP82-076	225	197	7	24	2	45
XL85-0140	CP77-405	CP72-355	209	143	8	35	1	22
XL85-0154	CP77-405	LCP81-030	704	580	30	44	2	5
XL85-0003	CP77-413	85P1	242	242	26	91	4	79
XL85-0117	CP77-414	CP67-412	252	228	6	15	2	39
XL85-0272	CP77-414	CP70-321	161	131	5	24	2	61
XL85-0033	CP77-414	CP80-323	237	203	16	73	2	39
XL85-0076	CP77-414	LCP81-030	588	588	31	57	5	45
XL85-0261	CP77-416	CP76-301	252	226	14	62	1	13
XL85-0190	CP78-304	CP78-304	43	32	3	74	.	.
XL85-0198	CP78-317	CP62-258	200	178	17	84	.	.
XL85-0010	CP78-317	CP72-355	669	669	37	61	13	84
XL83-0104	CP78-317	CP76-301	483	325	10	10	4	39
XL85-0207	CP78-357	CP73-351	154	125	6	37	.	.
XL85-0107	CP78-357	CP76-331	249	227	15	67	.	.
XL85-0077	CP78-357	LCP81-030	405	395	31	80	7	79
XL85-0293	CP79-300	LCP83-152	80	73	6	79	.	.
XL83-0070	CP79-301	CP62-258	450	364	36	82	15	96
XL83-0096	CP79-301	CP69-373	529	443	22	42	6	57
XL83-0105	CP79-311	CP76-301	218	177	2	2	.	.
XL83-0219	CP79-311	LCP81-030	1534	1301	46	22	12	39
XL85-0254	CP79-318	CP69-1052	205	187	17	83	2	51
XL85-0217	CP79-318	CP70-321	491	424	18	33	3	28
XL85-0266	CP79-318	CP72-1312	232	202	4	6	.	.
XL85-0169	CP79-318	CP73-351	194	178	8	41	.	.
XL85-0187	CP79-318	CP76-301	184	127	6	28	2	57
XL85-0245	CP79-318	CP80-313	206	194	.	.	.	.
XL85-0147	CP79-318	LCP81-030	688	577	37	59	5	34
XL85-0268	CP79-318	LCP82-089	257	221	10	37	.	.
XL85-0197	CP79-332	CP62-258	464	457	25	59	3	28
XL85-0249	CP79-332	CP66-346	233	232	6	17	1	13
XL85-0165	CP79-332	CP69-1052	492	460	30	68	7	69
XL85-0226	CP79-332	CP70-321	937	852	57	68	8	45

Table 5 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LINE1	R* ANKS1	LINE2	R* ANKS2
XL85-0162	CP79-332	CP72-355	537	521	35	72	6	57
XL85-0129	CP79-332	CP73-351	708	698	29	41	8	57
XL85-0212	CP79-332	CP76-331	223	223	20	86	1	13
XL85-0234	CP79-332	LCP81-030	187	176	10	57	1	22
XL85-0127	CP79-348	CP69-373	505	467	14	20	.	.
XL85-0023	CP79-348	CP72-355	301	264	14	48	2	34
XL85-0015	CP79-348	CP76-331	481	475	28	64	3	28
XL85-0043	CP79-348	LCP81-030	690	634	45	72	13	84
XL85-0322	CP79-348	LCP83-172	235	232	26	92	6	93
XL85-0311	CP79-348	LCP83-198	191	189	6	24	.	.
XL85-0307	CP79-348	L83-183	239	271	10	42	3	64
XL85-0123	CP80-313	CP69-373	175	128	26	98	4	88
XL85-0028	CP80-313	CP70-321	91	91	4	45	.	.
XL85-0009	CP80-313	CP72-355	467	426	25	59	6	64
XL85-0116	CP80-313	CP75-308	96	88	3	24	.	.
XL85-0031	CP80-313	CP80-323	283	246	9	26	2	34
XL85-0236	CP80-313	LCP81-030	162	139	4	16	1	28
XL85-0224	CP80-319	CP69-1052	116	105	9	80	4	97
XL85-0279	CP80-319	CP76-301	242	221	21	85	1	13
XL85-0231	CP80-319	CP77-310	123	123	9	76	1	39
XL85-0178	CP80-319	LCP81-030	242	222	9	33	1	13
XL85-0258	CP80-323	CP73-351	245	219	22	86	3	61
XL85-0087	CP80-324	CP77-310	70	70	1	5	.	.
XL85-0134	CP80-328	CP70-321	474	415	28	66	6	64
XL85-0164	CP80-328	CP72-355	210	190	23	92	3	69
XL85-0280	CP80-328	CP76-301	222	225	25	94	1	22
XL85-0213	CP80-328	CP76-331	166	152	5	22	.	.
XL85-0150	CP80-328	LCP81-030	261	215	10	35	1	13
XL85-0281	CP80-351	CP66-346	253	218	32	96	9	98
XL85-0142	CP80-351	CP74-2013	233	199	12	56	1	13
XL85-0262	CP80-351	CP76-301	249	205	24	88	6	89
XL85-0220	CP80-351	LCP81-030	238	201	24	90	6	91
XL85-0082	CP80-352	CP70-321	438	348	16	33	5	57
XL85-0113	CP80-352	CP73-351	472	414	16	29	1	2
XL85-0214	CP80-352	CP76-301	248	234	23	87	5	86
XL85-0086	CP80-352	CP77-310	68	60	2	20	1	72
XL85-0160	CP80-356	CP62-258	485	444	27	62	.	.
XL85-0250	CP80-356	CP66-346	218	212	5	13	.	.
XL85-0237	CP80-356	CP67-412	432	350	8	8	1	2
XL85-0255	CP80-356	CP69-1052	243	235	18	78	.	.
XL85-0135	CP80-356	CP70-321	223	218	11	51	1	13
XL85-0267	CP80-356	CP72-1312	245	210	11	46	1	13

Table 5 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LINE1NO	R* ANKS 1	LINE2NO	R* ANKS 2
XL85-0094	CP80-356	CP73-351	400	400	9	13	.	.
XL85-0143	CP80-356	CP74-2013	238	193	27	94	2	39
XL85-0040	CP80-356	LCP81-030	429	426	13	22	1	2
XL85-0264	CP80-356	LCP82-089	230	207	.	.	.	.
XL85-0200	CP80-356	L75-002	381	333	6	6	4	51
XL85-0298	CP80-360	CP76-331	215	186	16	78	3	69
XL85-0316	CP80-360	LCP81-030	145	114	8	61	.	.
XL85-0016	CP81-307	CP57-614	234	226	5	10	.	.
XL85-0002	CP81-307	CP74-2013	214	212	15	74	.	.
XL85-0313	CP81-311	L83-194	204	182	15	78	2	51
XL85-0318	CP82-528	L78-063	234	228	6	17	1	13
XL85-0310	CP82-559	LCP83-198	226	191	18	82	3	64
XL85-0122	LCP81-005	CP62-258	86	86	5	64	.	.
XL85-0130	LCP81-005	CP73-351	522	463	16	24	5	51
XL85-0093	LCP81-005	CP76-331	65	65	4	69	.	.
XL85-0153	LCP81-005	LCP81-030	494	494	32	72	3	28
XL85-0185	LCP81-009	CP70-321	223	222	4	7	1	13
XL85-0235	LCP81-009	LCP81-030	225	220	8	31	2	45
XL85-0287	LCP81-010	LCP83-133	231	206	23	89	1	13
XL85-0131	LCP81-012	CP73-351	204	189	11	59	4	86
XL85-0180	LCP81-012	LCP81-030	240	222	27	94	6	91
XL85-0208	LCP81-018	CP67-412	128	127	3	13	.	.
XL85-0184	LCP81-018	CP70-321	157	149	5	26	1	28
XL85-0282	LCP81-018	CP76-331	213	185	.	.	.	.
XL85-0136	LCP81-023	CP70-321	235	230	8	29	.	.
XL85-0241	LCP82-033	CP67-412	115	103	8	74	.	.
XL85-0163	LCP82-033	CP72-355	261	224	12	48	4	72
XL85-0215	LCP82-033	CP76-301	215	188	13	67	3	69
XL85-0232	LCP82-033	CP77-310	222	211	26	95	6	94
XL85-0221	LCP82-033	LCP81-030	286	223	2	1	.	.
XL85-0177	LCP82-045	LCP81-030	225	222	7	24	2	45
XL85-0115	LCP82-046	CP72-355	204	183	17	83	4	86
XL85-0081	LCP82-046	LCP81-030	469	465	9	8	4	45
XL85-0225	LCP82-047	CP69-1052	251	138	33	96	4	76
XL85-0225	LCP82-047	CP69-1052	251	138	33	96	4	76
XL85-0183	LCP82-047	CP70-321	250	250	.	.	.	.
XL85-0152	LCP82-047	LCP81-030	199	199	5	16	2	51
XL85-0242	LCP82-057	CP67-412	219	195	3	5	.	.
XL85-0274	LCP82-057	CP70-321	87	78	14	98	2	88
XL85-0188	LCP82-058	CP69-1052	202	175	10	53	.	.
XL85-0219	LCP82-058	CP70-321	170	141	18	91	2	61
XL85-0211	LCP82-058	CP76-331	180	142	.	.	.	.

Table 5 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LINE1	R* ANKS1	LINE2	R* ANKS2
XL85-0271	LCP82-064	CP70-321	89	83	4	46	.	.
XL85-0260	LCP82-064	CP76-301	126	120	7	62	2	76
XL85-0181	LCP82-064	LCP81-030	115	123	3	17	.	.
XL85-0141	LCP82-073	CP72-355	175	169	4	13	.	.
XL85-0078	LCP82-073	LCP81-030	484	425	11	13	.	.
XL85-0238	LCP82-089	CP67-412	203	186	4	9	.	.
XL85-0265	LCP82-089	LCP82-089	51	35	1	9	.	.
XL85-0108	LCP82-097	CP70-321	47	33	3	70	.	.
XL85-0100	LCP82-097	CP72-2086	206	149	8	37	1	22
XL85-0079	LCP82-097	LCP81-030	202	156	13	70	3	72
XL85-0331	LCP83-129	LCP81-030	129	124	11	84	1	39
XL85-0325	LCP83-154	LCP81-030	155	50	10	72	3	84
XL85-0315	LCP83-163	CP77-402	210	173	10	49	3	69
XL85-0204	L65-069	CP57-614	223	170	6	19	.	.
XL85-0074	L65-069	CP67-412	173	117	18	90	1	28
XL85-0145	L65-069	CP76-301	204	153	8	37	2	51
XL85-0158	L75-002	85P2	69	67	4	64	.	.
XL85-0161	L79-034	CP72-355	450	386	18	39	1	2
XL85-0243	L79-034	L82-107	191	182	22	95	2	51
XL85-0080	L80-035	LCP81-030	219	195	24	92	.	.
XL83-0203	L80-040	CP62-258	435	411	31	75	5	57
XL85-0199	L82-107	CP69-373	127	114	12	87	2	76
XL85-0244	L82-107	L82-107	50	46	5	89	.	.
XL85-0227	US74-90	CP70-321	66	66	2	22	.	.
XL85-0205	US74-90	CP73-351	243	225	.	.	.	.
XL85-0083	US77-17	CP70-321	451	456	20	45	2	13
XL85-0175	US77-17	LCP81-030	236	236	8	29	1	13
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SUM			73620	64094	3582		618	

* RANKS1, and RANKS2 refer to percentile rank of each cross based on percent advancement from SURVIVE through LINE1 and LINE2 respectively.

Table 6. List of crosses of the 1986 crossing series and the percent advancement of their progenies through the first line trial stage planted in 1988.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LINE1NO	R*ANKS1
XL85-170			376	216	12	29
XL85-149	COLD TOL	LCP81-030	139	136	13	86
XL86-136	CP48-103	CP48-103	202	135	.	.
XL84-221	CP48-103	CP62-258	1159	702	31	22
XL83-157	CP48-103	CP77-310	224	134	9	41
XL86-040	CP48-103	LCP81-030	243	171	46	98
XL86-091	CP48-103	L83-194	243	205	7	23
XL85-050	CP52-068	CP75-308	196	155	6	27
XL86-051	CP57-614	CP57-614	249	172	20	79
XL86-255	CP61-037	CP69-1052	174	134	7	41
XL86-204	CP61-037	CP73-351	262	214	11	45
XL86-176	CP61-037	CP77-310	247	209	4	7
XL86-345	CP61-037	CP82-520	77	63	8	91
XL86-154	CP61-037	LCP82-047	217	161	20	85
XL86-230	CP61-037	LCP82-089	243	153	12	56
XL86-315	CP61-037	LCP84-239	199	140	16	79
XL86-143	CP62-258	CP62-258	173	130	.	.
XL86-121	CP65-357	CP48-103	227	202	4	9
XL86-308	CP65-357	CP57-614	216	189	12	61
XL85-196	CP65-357	CP62-258	368	245	17	52
XL84-270	CP65-357	CP72-2086	220	195	3	7
XL86-274	CP65-357	CP76-331	236	201	25	91
XL83-108	CP65-357	CP77-402	512	367	10	11
XL86-177	CP65-357	CP80-323	245	223	28	93
XL86-102	CP65-357	CP81-325	220	160	5	17
XL86-317	CP65-357	CP83-657	213	173	7	31
XL83-212	CP65-357	LCP81-030	372	147	21	61
XL86-214	CP65-357	LCP82-089	243	227	8	31
XL84-273	CP65-357	L65-069	834	558	39	53
XL86-089	CP65-357	L83-194	225	176	12	59
XL86-311	CP65-357	L84-290	227	177	5	16
XL86-141	CP66-346	CP66-346	244	199	5	11
XL86-180	CP70-300	CP72-370	238	171	12	58
XL85-247	CP70-321	CP66-346	182	145	13	76
XL86-297	CP70-321	86P5	187	148	.	.
XL83-047	CP70-330	CP67-412	106	68	2	9
XL86-132	CP70-330	CP72-355	246	192	20	80
XL86-163	CP70-330	CP74-383	242	190	4	8
XL86-247	CP70-330	CP80-313	167	136	9	60
XL85-110	CP70-330	LCP81-030	1150	824	38	31
XL86-172	CP70-330	LCP82-058	248	201	9	35

Table 6 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LIN1NO	R*ANKS1
XL86-273	CP70-330	LCP82-089	202	167	4	11
XL86-019	CP70-330	LCP83-158	230	153	17	78
XL84-279	CP70-330	L75-002	366	285	16	49
XL86-160	CP70-330	L77-038	234	197	10	47
XL86-164	CP72-1210	CP74-383	249	200	12	54
XL86-110	CP72-1210	86P3	197	143	2	3
XL86-322	CP72-1312	CP72-1312	227	186	6	20
XL86-152	CP72-1312	LCP82-046	240	163	1	1
XL86-111	CP72-1312	86P3	247	206	8	29
XL86-359	CP72-1312	86P7	163	139	8	56
XL84-256	CP72-355	CP67-412	1158	886	23	11
XL86-033	CP72-355	CP72-355	224	159	11	56
XL83-161	CP72-355	CP77-310	778	559	50	68
XL84-202	CP72-355	LCP81-030	222	190	12	60
XL86-001	CP72-355	86P1	165	110	6	35
XL86-006	CP72-355	86P2	232	181	29	95
XL86-157	CP72-355	86P3	234	201	11	53
XL86-183	CP72-355	86P4	240	206	21	82
XL84-251	CP72-370	CP62-258	195	151	17	81
XL85-097	CP72-370	CP73-351	193	152	13	72
XL85-111	CP72-370	LCP81-030	156	127	13	80
XL83-116	CP72-370	L65-069	330	244	10	25
XL86-049	CP73-340	CP57-614	226	168	23	89
XL86-003	CP73-340	86P1	220	189	30	96
XL86-235	CP73-345	CP77-407	420	360	37	82
XL84-283	CP73-345	LCP81-030	238	196	15	67
XL86-298	CP73-351	86P5	107	107	11	90
XL86-253	CP74-328	CP73-351	175	98	7	41
XL86-036	CP74-328	LCP81-030	238	189	29	95
XL86-185	CP74-328	86P4	228	182	.	.
XL86-117	CP74-383	CP74-2013	243	228	14	63
XL86-046	CP74-383	CP74-328	240	176	27	92
XL86-027	CP74-383	CP76-331	239	216	16	72
XL83-218	CP74-383	LCP81-030	219	128	7	29
XL84-168	CP74-383	LCP81-030	165	133	5	25
XL86-063	CP74-383	LCP81-030	190	127	4	14
XL86-090	CP74-383	L83-194	245	186	22	83
XL86-010	CP75-1091	86P2	236	175	15	68
XL85-132	CP75-308	CP70-321	230	166	1	1
XL86-232	CP75-327	CP73-351	210	177	8	38
XL86-127	CP75-361	LCP81-030	234	169	17	77
XL84-218	CP76-331	CP62-258	166	143	7	45

Table 6 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LINE1NO	R*ANKS1
XL86-016	CP76-331	CP76-331	116	81	6	59
XL86-114	CP76-331	86P3	147	123	.	.
XL86-054	CP77-310	CP77-310	252	193	17	72
XL86-045	CP77-402	CP77-402	230	153	7	25
XL85-140	CP77-405	CP72-355	474	236	10	14
XL86-197	CP77-405	CP80-323	215	137	8	36
XL86-004	CP77-405	86P1	220	110	9	44
XL86-120	CP77-405	86P3	224	135	1	1
XL86-191	CP77-405	86P4	244	213	3	4
XL86-236	CP77-407	CP77-407	220	151	7	29
XL86-190	CP77-407	86P4	253	226	11	47
XL86-072	CP77-414	CP74-1094	241	191	.	.
XL85-076	CP77-414	LCP81-030	198	162	6	25
XL86-131	CP78-317	CP72-355	253	232	.	.
XL86-137	CP78-317	CP73-343	235	202	48	99
XL83-104	CP78-317	CP76-301	758	588	2	0
XL86-055	CP78-317	CP76-331	249	190	38	97
XL86-166	CP78-317	CP78-357	236	215	6	18
XL84-222	CP78-317	LCP81-030	456	323	26	62
XL86-138	CP78-317	LCP81-030	1081	984	69	68
XL86-018	CP78-317	L75-056	198	180	13	71
XL84-198	CP78-357	CP73-351	197	165	2	3
XL84-278	CP78-357	CP77-407	579	474	20	33
XL86-167	CP78-357	CP78-357	146	127	4	22
XL86-158	CP78-357	86P3	237	183	17	77
XL83-096	CP79-301	CP69-373	475	281	30	67
XL83-105	CP79-311	CP76-301	221	130	8	35
XL83-219	CP79-311	LCP81-030	376	295	14	36
XL84-231	CP79-318	CP70-321	209	188	9	47
XL86-108	CP79-318	CP74-2013	235	209	6	20
XL86-199	CP79-318	CP75-1082	240	197	7	23
XL85-147	CP79-318	LCP81-030	657	502	38	63
XL86-216	CP79-318	LCP82-089	252	220	29	93
XL86-146	CP79-318	LCP83-126	239	212	20	81
XL86-193	CP79-318	86P4	237	176	16	73
XL83-057	CP79-332	CP62-258	341	276	15	49
XL85-197	CP79-332	CP62-258	953	953	.	.
XL85-226	CP79-332	CP70-321	322	291	.	.
XL86-124	CP79-332	CP73-343	245	224	5	11
XL86-162	CP79-332	CP74-383	232	212	30	96
XL86-198	CP79-332	CP75-1082	237	194	11	52
XL84-299	CP79-332	CP75-308	1102	1015	53	54

Table 6 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LIN1 NO	R* ANKS 1
XL86-074	CP79-332	CP76-331	214	206	13	65
XL86-139	CP79-332	LCP81-030	251	223	23	85
XL86-215	CP79-332	LCP82-089	253	215	10	41
XL86-148	CP79-332	L78-063	255	210	14	61
XL86-013	CP79-348	LCP81-030	252	221	24	86
XL86-030	CP79-348	L75-056	248	204	10	41
XL86-071	CP80-313	CP74-328	188	127	17	83
XL86-122	CP80-313	CP76-331	204	174	6	23
XL84-254	CP80-313	LCP81-030	510	357	26	58
XL86-238	CP80-313	LCP81-030	227	197	14	66
XL86-144	CP80-313	L77-038	205	178	12	64
XL86-002	CP80-313	86P1	128	88	5	39
XL86-007	CP80-313	86P2	251	160	5	11
XL86-119	CP80-313	86P3	138	124	19	97
XL86-189	CP80-313	86P4	247	177	16	70
XL86-295	CP80-313	86P5	166	143	7	45
XL84-203	CP80-329	LCP81-030	168	152	10	65
XL86-032	CP80-356	CP72-355	229	183	16	75
XL86-042	CP80-356	CP77-402	233	171	10	47
XL86-207	CP81-325	CP72-355	237	210	11	52
XL86-234	CP81-329	CP73-351	249	209	38	97
XL86-159	CP81-329	86P3	241	192	.	.
XL86-069	CP81-332	CP57-614	221	173	22	88
XL86-058	CP81-332	CP76-331	149	142	6	41
XL86-202	CP81-332	CP80-323	178	136	7	39
XL86-125	CP81-332	LCP83-133	155	145	11	76
XL86-332	CP82-512	L84-229	239	216	6	18
XL86-062	CP82-513	LCP81-030	249	202	.	.
XL86-326	CP82-519	86P6	164	152	15	84
XL86-178	CP82-527	CP80-323	248	200	17	74
XL86-123	CP82-537	CP76-331	225	205	7	27
XL86-188	CP82-537	86P4	241	209	10	44
XL86-320	CP82-552	CP72-1312	236	215	24	89
XL86-196	CP82-559	CP80-323	249	229	16	68
XL86-307	CP83-606	CP57-614	224	191	15	72
XL86-346	CP83-626	CP82-520	142	134	17	94
XL86-330	CP83-626	86P6	202	175	12	64
XL86-300	CP83-628	L84-261	169	142	4	18
XL86-310	CP83-628	L84-290	191	160	.	.
XL86-309	CP83-634	L84-290	244	217	8	31
XL86-299	CP83-644	L84-261	172	145	16	85
XL84-224	LCP81-005	LCP81-030	554	398	18	29

Table 6 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LINE1NO	R*ANKS1
XL86-083	LCP81-010	CP72-355	242	199	11	50
XL86-116	LCP81-010	CP74-2013	240	184	5	14
XL86-073	LCP81-010	CP76-331	227	197	16	75
XL86-077	LCP81-010	LCP81-030	248	156	22	83
XL86-213	LCP81-010	LCP82-089	231	190	27	94
XL86-039	LCP81-010	L75-056	249	227	3	4
XL84-310	LCP81-012	CP70-321	20	20	2	88
XL84-244	LCP81-023	L65-069	1047	780	42	41
XL86-017	LCP81-030	LCP81-030	206	181	9	49
XL86-113	LCP81-030	86P3	236	212	.	.
XL86-128	LCP82-046	LCP81-030	242	216	5	14
XL85-183	LCP82-047	CP70-321	421	306	13	27
XL86-155	LCP82-047	LCP82-047	210	156	4	9
XL86-254	LCP82-058	CP69-1052	200	173	14	75
XL85-211	LCP82-058	CP76-331	166	104	7	45
XL86-296	LCP82-089	86P5	153	114	2	6
XL86-028	LCP82-094	CP76-331	209	190	64	99
XL86-015	LCP82-094	LCP81-030	243	210	28	93
XL86-020	LCP82-094	LCP83-158	240	207	23	87
XL86-099	LCP82-094	L78-063	246	187	14	62
XL86-186	LCP82-094	86P4	243	193	12	56
XL86-034	LCP83-119	LCP81-030	218	158	9	44
XL86-005	LCP83-119	86P1	242	195	5	14
XL86-147	LCP83-126	LCP83-126	167	108	11	71
XL86-052	LCP83-133	CP77-310	240	191	5	14
XL86-041	LCP83-135	LCP81-030	232	148	22	86
XL86-096	LCP83-135	LCP83-135	232	144	6	20
XL86-011	LCP83-140	CP76-331	246	222	3	4
XL86-044	LCP83-140	CP77-402	239	134	18	78
XL86-078	LCP83-154	LCP81-030	244	136	10	44
XL86-187	LCP83-154	86P4	166	139	.	.
XL86-031	LCP83-165	CP72-355	234	202	6	20
XL86-023	LCP83-165	CP76-331	236	159	9	38
XL86-014	LCP83-165	LCP81-030	246	197	25	89
XL86-095	LCP83-165	LCP83-135	242	171	16	71
XL86-251	LCP83-179	CP80-356	227	140	8	33
XL86-241	LCP83-179	LCP81-030	248	220	28	92
XL86-327	LCP84-222	86P6	154	131	7	50
XL86-100	LCP86-391	L78-063	206	168	6	23
XL86-092	LCP86-391	L83-194	239	118	3	6
XL83-117	L65-069	L65-069	1252	665	15	4
XL84-252	L77-038	CP62-258	897	708	44	56

Table 6 continued.

CROSS	FEMALE	MALE	SURVIVE	OWINTER	LINE1	RANKS1*
XL86-145	L77-038	L77-038	233	170	6	20
XL83-204	L78-035	CP62-258	199	126	8	41
XL86-101	L78-063	L78-063	186	110	3	7
XL86-192	L78-063	86P4	246	185	12	56
XL86-222	L79-012	CP73-351	238	178	.	.
XL83-185	L79-018	LCP81-026	219	129	5	17
XL84-169	L80-035	LCP81-030	399	147	17	47
XL83-203	L80-040	CP62-258	1066	670	26	18
XL84-298	L80-35	L75-002	939	604	46	56
XL86-210	L83-193	LCP81-030	221	165	14	67
XL86-048	L83-194	CP57-614	218	140	22	89
XL86-205	L83-194	CP73-351	231	205	6	20
XL86-093	L83-194	L83-194	219	114	2	2
XL86-285	L84-218	CP74-383	200	174	13	70
XL86-291	L84-218	L84-273	163	137	8	56
XL86-306	L84-224	CP74-383	149	112	2	6
XL86-290	L84-224	L84-273	172	124	1	2
XL86-293	L84-244	CP83-646	195	170	7	35
XL86-304	L84-244	L84-262	232	209	8	32
XL86-325	L84-253	86P6	116	98	9	78
XL86-305	L84-262	L84-262	97	69	2	14
XL86-354	L84-263	86P7	196	168	7	35
XL86-331	L84-288	86P6	64	50	2	27
XL83-103	US77-017	CP77-310	868	485	32	36
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SUM			65712	50313	3264	

* RANKS1 refers to percentile rank of each cross based on percent advancement from SURVIVE through LINE1.

PERFORMANCE OF NURSERIES AT THE IBERIA RESEARCH STATION

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Nursery tests conducted at the Iberia Station for the last three years have clearly shown the advantages of using multiple locations in the nursery stage of the variety development program. The additional location has allowed for quicker identification of clones that exhibit erratic behavior in certain location/environment combinations. Increased testing more closely mirrors the broad range of conditions encountered by the growers across the sugar belt. In a sense, varietal performance across multiple locations represents a futuristic look at just how well the varieties are generally adapted to the cane growing regions.

An examination of the yield of certain entries in the nursery testing program personifies the consequences of limiting the testing locations to one or two sites. LCP 86-450 yielded quite well on the light-textured soil at St. Gabriel, but performed, relative to the other entries, poorly on the heavy-textured soils at Iberia and St. Gabriel[1/]. Conversely, LCP 86-458 yielded well on the heavy-textured soil at Iberia, but did relatively poorly at both St. Gabriel sites. It is easy to see how a breeder would judge both clones harshly and discard them from the program, because of weakness at one or more sites. However, a breeder's ability to make accurate decisions concerning these two clones would have been in jeopardy had only one or two sites been planted.

As many locations as resources permit should be utilized to identify inferior varieties early, to avoid the enormous expense, in time and effort, of advancing undesirable germplasm. Also, success, or rate of genetic gain, of the Louisiana sugarcane variety development program is predicated on the early selection and recycling, as parents, of superior experimental varieties.

[1/] Refer to "1988 Louisiana (L) Nursery Variety Trials".

Performance of nursery germplasm:

Table 1 includes the second stubble results of the nursery trial of the 1985 L series planted at the Iberia Station. Five of the original 32 experimental clones have been advanced to the outfield program for seed increase. Of the five, LCP 85-384 appears very well adapted to both test locations and LCP 85-336 exhibited outstanding ratooning ability at Iberia.

First stubble data for the 1986 L series at Iberia are presented in Table 2. Twenty-three of the original forty entries remain in the testing program. Most of the culled clones possessed either low sugar yields or little smut resistance. Four assignments, LCP 86-408, LCP 86-412, LCP 86-454, and LCP 86-457, have demonstrated very high yields at all three nursery sites.

Table 3 shows the plant cane performance of the 1987 assignments. Yields of entries with acceptable agronomic ratings were varied, ranging from a low of 4821 pounds of sugar per acre for the commercial variety CP 65-357 to over 11,000 pounds of sugar per acre for one of the experimentals. Ratoon information must be gathered to determine overall suitability of the 1987 L series.

Table 1. The 1988 nursery variety trial results from second stubble of the 1985 L series on Baldwin silty clay loam at the Iberia Research Station.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	JUICE SUCROSE (%)
CP 65-357	5488	201	27.1	1.80	29948	14.6
CP 70-321	8814	225	39.1	2.09	37435	16.0
CP 74-383	7753	225	34.4	1.97	34939	15.9
LCP 85-298	7967	197	40.2	1.74	46283	14.3
LCP 85-307*	8900	264	33.8	1.59	42653	18.2
LCP 85-316*	8446	232	35.7	1.54	45602	16.4
LCP 85-336	13869	212	65.0	1.73	74869	15.2
LCP 85-341*	5520	220	25.1	1.32	38115	15.7
LCP 85-352	6476	210	30.8	1.42	43561	15.2
LCP 85-376	8979	226	39.3	1.84	42653	16.1
LCP 85-384	11527	220	52.5	1.63	64206	15.6
MSD(.05)	NS	NS	21.4	NS	14334	NS

Planting date: 11/14/85 Harvest date: 10/13/88

* Sampled for breeding purposes only.

Table 2. The 1988 nursery variety trial results from first stubble of the 1986 L series on Baldwin silty clay loam at the Iberia Research Station.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	FIBER (%)	JUICE SUCROSE (%)
CP 65-357	9217	240	40.5	2.43	31990	13.3	16.7
CP 70-321	8109	247	34.5	2.07	33351	11.0	17.1
CP 74-383	11640	222	56.3	2.41	46737	11.1	15.7
LCP 86-393	13866	245	58.8	2.56	45829	14.7	17.0
LCP 86-395	10429	244	45.0	1.76	51274	11.2	17.0
LCP 86-402	12628	212	61.7	2.95	41972	11.3	15.1
LCP 86-408	14990	233	66.4	2.38	55585	11.3	16.3
LCP 86-411	11217	232	51.5	2.17	47190	15.0	16.3
LCP 86-412	15004	242	65.1	2.71	48098	10.4	16.8
LCP 86-414	7331	202	36.7	1.67	44695	11.7	14.7
LCP 86-419	10813	256	47.3	2.75	34485	13.9	17.6
LCP 86-420	12122	273	46.8	2.19	42653	13.3	18.9
LCP 86-422*	10827	256	45.4	2.82	32443	12.8	17.6
LCP 86-426	10424	242	45.3	1.83	49459	13.6	16.8
LCP 86-429	11180	200	58.6	2.37	49459	14.1	14.3
LCP 86-434	10273	233	47.8	2.35	40838	13.9	16.2
LCP 86-435	9666	228	43.4	2.24	38796	11.6	16.0
LCP 86-438	9898	217	47.8	2.76	34712	12.6	15.3
LCP 86-447	12266	232	55.4	2.94	37662	15.4	16.2
LCP 86-448*	8314	264	32.9	1.96	33805	12.6	18.2
LCP 86-450	9292	214	46.6	2.57	36073	11.5	15.1
LCP 86-451	12794	256	51.8	2.02	51501	13.6	17.5
LCP 86-453	13334	264	52.6	2.84	37662	11.5	18.2
LCP 86-454	12586	251	52.1	2.73	38342	11.8	17.4
LCP 86-456*	11488	264	45.0	1.58	56492	15.1	18.2
LCP 86-457	11725	217	57.4	2.44	46964	11.0	15.3
LCP 86-458	12509	221	59.5	2.89	41292	12.3	15.6
LCP 86-463	8866	255	36.4	2.19	33578	13.0	17.7
LCP 86-468	11326	237	49.0	2.27	43107	12.1	16.6
MSD(.05)	4992	24	20.4	0.70	10788	1.4	1.4

Planting date: 10/21/86 Harvest date: 11/16/88

* Sampled for breeding purposes only.

Table 3. The 1988 nursery variety trial results from plant cane of the 1987 L series on Baldwin silty clay loam at the Iberia Research Station.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	FIBER (%)	JUICE SUCROSE (%)
CP 65-357	4281	273	15.1	1.84	15881	12.6	18.7
CP 70-321	7417	277	25.8	2.44	19965	11.2	18.9
CP 74-383	9114	238	37.2	2.67	26318	11.7	16.5
LCP 87-001	9133	219	39.8	2.33	33275	11.9	15.4
LCP 87-002	9002	239	37.0	2.59	27225	15.1	16.7
LCP 87-003	7558	207	35.1	2.86	24049	13.2	14.8
LCP 87-004	6320	251	24.8	1.78	27528	11.8	17.2
LCP 87-005	7698	219	33.8	2.59	27074	13.7	15.4
LCP 87-010	8239	227	34.9	2.33	31006	13.2	15.9
LCP 87-012	10684	202	51.0	2.83	34031	13.2	14.5
LCP 87-013	8186	261	31.0	2.42	26772	15.3	17.9
LCP 87-014	6510	224	28.3	2.24	24805	12.7	15.8
LCP 87-017	10647	230	45.5	2.76	34637	13.6	16.2
LCP 87-018	6271	223	27.9	1.95	29494	12.4	15.7
LCP 87-019	9165	232	37.0	2.37	29494	12.5	16.1
LCP 87-020	7925	230	32.4	2.28	26469	10.9	16.1
LCP 87-023	10852	248	40.6	2.74	28587	11.4	17.1
LCP 87-024	7421	198	35.3	2.89	25259	11.6	14.4
LCP 87-025	4770	234	19.7	1.86	21024	13.6	16.4
LCP 87-472	9429	206	44.3	2.53	34637	12.3	14.7
LCP 87-473	8986	227	39.3	2.75	28435	13.5	15.8
LCP 87-474	6774	204	31.8	2.15	28586	14.7	14.8
LCP 87-477	8932	210	42.1	2.72	31158	10.8	15.1
LCP 87-478	5642	213	26.1	1.90	24654	10.7	14.9
LCP 87-479	9851	216	43.4	2.54	34788	12.8	15.1
LCP 87-483	5245	257	19.1	1.23	30553	9.9	17.8
LCP 87-486	9645	228	40.5	2.43	33275	13.8	15.9
LCP 87-490	7128	260	25.9	2.35	21780	14.5	17.9
LCP 87-491	7424	257	27.6	1.79	30401	12.4	17.7
LCP 87-492	6556	242	25.5	2.09	23898	12.8	16.7
LCP 87-494	8375	218	37.8	2.70	28738	12.6	15.4
LCP 87-495	8033	241	32.6	2.09	30401	10.6	16.8
LCP 87-496	11380	231	47.1	2.64	37057	13.3	16.0
LCP 87-497	7782	246	30.3	2.19	28284	11.9	17.2
LCP 87-499	8545	260	32.2	2.86	20872	13.3	17.8
MSD(.05)	4304	22	20.2	0.62	18008		1.3

Planting date: 10/16/87 Harvest date: 11/16/88

1988 LOUISIANA (L) NURSERY VARIETY TRIALS

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Five years after the initial crossing of parents, selected clones are assigned permanent numbers by the Louisiana (L) Sugarcane Variety Improvement Program. The new assignments are then planted in the first replicated tests of the selection program. These tests are called the nursery variety trials.

The objective of the selection program is to identify and select varieties that will perform well across the range of environments a commercial variety will encounter. To realize this objective the program tests new varieties in as many locations as possible. Over the last few years the program has increased the number of these locations. The locations involved are: the St. Gabriel Research Station in St. Gabriel, LA, the Iberia Research Station near Jeanerette, LA, Triple V Farms near Youngsville, LA, and Westfield Plantation near Paincourtville, LA.

Nursery trials were planted in single row (six foot centers), 16 foot long plots using two replications per location. Location, soil type, planting and harvest dates are summarized in Table 1. A randomized complete block design and three commercial check varieties (CP 65-357, CP 70-321, and CP 74-383) were used in each trial.

Number of stalks per plot was counted in September. At harvest, ten stalk, hand cut samples were used to estimate stalk weight and provide a juice sample for sucrose analysis. Crusher juice was analysed for sucrose by polarization and Brix was measured by refractometer. Theoretical recoverable sugar (TRS) was calculated according to the methods described by Legendre and Henderson (1972). Fiber estimates were made for the 1986 and 1987 series using a four stalk sample and the chip-press method (Tanimoto, 1964). Cane yield was estimated as the product of stalk weight and stalk number. Sugar yield was calculated as the product of TRS and cane yield.

Analysis of variance was performed for each crop and assignment series over and by soil type. Minimum significant differences (MSD) were calculated by the Waller-Duncan multiple range test (SAS, 1985).

Table 1. Planting date and harvest dates of nursery tests planted or harvested in 1988.

Series	Location	Soil* Texture	Planting Date	Harvest Dates 1986	1987	1988
1985	St. Gabriel	C.s.l.	10/22/85	12/04	11/04	10/06
1985	Iberia	B.s.c.	10/14/85	11/19	11/19	10/13
1986	St. Gabriel	C.s.l	10/22/86		11/06	11/10
1986	St. Gabriel	S.c.	10/21/86		-----	11/07
1986	Iberia	B.s.c.	10/30/86		11/16	11/16
1987	St. Gabriel	C.s.l.	10/19/87		11/19	11/29
1987	St. Gabriel	S.c.	10/14/87			11/29
1987	Iberia	B.s.c.	10/16/87			11/16
1987	Westfield Plt.	S.s.c.	9/22/88			
1987	Triple V Farms	Co.s.l.	9/08/88			
1988	St. Gabriel	C.s.l.	10/14/88			
1988	St. Gabriel	S.c.	10/07/88			
1988	Iberia	B.s.c.	10/13/88			

* C.s.l. = Commerce silt loam S.c. = Sharkey clay
S.s.c. = Sharkey silty clay loam Co.s.l. = Coteau silt loam
B.s.c. = Baldwin silty clay loam

Table 2. The 1988 nursery variety trial means from second stubble of the 1985 L series over locations.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	JUICE SUCROSE (%)
CP 65-357	5278	194	27.2	1.82	29897	14.1
CP 70-321	8758	198	45.2	2.16	41707	14.3
CP 74-383	8715	207	42.4	2.03	41367	14.8
LCP 85-298	7480	180	41.1	1.73	48148	13.3
LCP 85-307*	9330	250	37.7	1.78	42602	17.4
LCP 85-316*	7306	219	32.8	1.62	40447	15.7
LCP 85-336	10257	197	50.7	1.76	57802	14.3
LCP 85-341*	6357	200	32.0	1.39	46047	14.5
LCP 85-352	7128	193	37.5	1.69	44367	14.1
LCP 85-376	8816	211	41.7	2.00	41644	15.2
LCP 85-384	11202	189	60.4	1.80	66890	13.8
MSD(.05)	5747	23	29.7	0.37	21234	1.4

* Sampled for breeding purposes only.

Table 3. The 1988 nursery variety trial results from second stubble of the 1985 L series on Commerce silt loam at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	JUICE SUCROSE (%)
CP 65-357	5069	187	27.3	1.83	29846	13.7
CP 70-321	8703	170	51.4	2.23	45980	12.6
CP 74-383	9677	188	50.3	2.08	47795	13.6
LCP 85-298	6993	163	42.1	1.72	50013	12.3
LCP 85-307*	9761	236	41.6	1.97	42551	16.5
LCP 85-316*	6165	207	29.9	1.70	35291	14.9
LCP 85-336	6644	182	36.4	1.79	40736	13.4
LCP 85-341*	6775	190	35.5	1.43	50013	13.9
LCP 85-352	7780	176	44.2	1.96	45173	13.0
LCP 85-376	8571	189	45.2	2.25	40132	13.8
LCP 85-384	10877	159	68.4	1.97	69574	11.9
MSD(.05)	4242	45	14.8	0.35	16920	2.6

Planting date: 10/22/85 Number of replications: 2
Harvest date: 10/06/88 Plot size: 18 feet, 1 row

* Sampled for breeding purposes only.

Table 4. The 1988 nursery variety trial results from second stubble of the 1985 L series on Baldwin silty clay loam at the Iberia Research Station.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	JUICE SUCROSE (%)
CP 65-357	5488	201	27.1	1.80	29948	14.6
CP 70-321	8814	225	39.1	2.09	37435	16.0
CP 74-383	7753	225	34.4	1.97	34939	15.9
LCP 85-298	7967	197	40.2	1.74	46283	14.3
LCP 85-307*	8900	264	33.8	1.59	42653	18.2
LCP 85-316*	8446	232	35.7	1.54	45602	16.4
LCP 85-336	13869	212	65.0	1.73	74869	15.2
LCP 85-341*	5520	220	25.1	1.32	38115	15.7
LCP 85-352	6476	210	30.8	1.42	43561	15.2
LCP 85-376	8979	226	39.3	1.84	42653	16.1
LCP 85-384	11527	220	52.5	1.63	64206	15.6
MSD(.05)	NS	NS	21.4	NS	14334	NS

Planting date: 11/14/85 Harvest date: 10/13/88

* Sampled for breeding purposes only.

Table 5. The 1988 nursery variety trial means from first stubble of the 1986 L series over three locations.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	FIBER (%)	JUICE SUCROSE (%)
CP 65-357	10332	243	41.8	2.35	34788	13.9	16.9
CP 70-321	10699	242	43.7	2.40	36376	11.6	16.7
CP 74-383	12064	226	53.2	2.36	45224	11.8	15.8
LCP 86-393	12380	230	53.4	2.49	42501	14.7	16.1
LCP 86-395	12729	244	51.0	2.10	48627	11.9	16.9
LCP 86-402	12013	206	56.3	3.02	37359	11.2	14.6
LCP 86-408	14159	225	62.1	2.19	56341	11.6	15.8
LCP 86-411	10328	236	45.8	2.14	42653	14.5	16.5
LCP 86-412	13851	230	59.5	2.91	41594	11.2	16.0
LCP 86-414	10087	218	45.3	2.20	41518	12.1	15.5
LCP 86-419	12532	252	50.0	2.81	35468	14.2	17.3
LCP 86-420	13009	257	50.8	2.10	48249	13.4	17.7
LCP 86-422*	11938	253	46.4	3.02	31082	13.6	17.3
LCP 86-426	11325	240	46.7	2.08	44997	14.3	16.7
LCP 86-429	12242	205	59.3	2.54	46736	14.5	14.5
LCP 86-434	10559	226	47.1	2.35	40081	13.7	15.7
LCP 86-435	11387	230	50.0	2.65	37964	12.3	16.1
LCP 86-438	10979	221	49.2	3.00	32821	13.2	15.5
LCP 86-447	12595	230	54.3	2.88	37737	15.5	16.0
LCP 86-448*	8113	246	33.1	2.06	32368	12.8	17.0
LCP 86-450	11414	207	54.6	2.92	36527	12.2	14.7
LCP 86-451	12847	236	51.9	2.35	44770	12.9	16.2
LCP 86-453	12952	248	51.1	2.88	35846	12.1	17.2
LCP 86-454	15186	250	60.9	2.86	42804	12.0	17.2
LCP 86-456*	12357	253	49.0	2.04	48778	14.8	17.5
LCP 86-457	14248	212	66.9	2.46	54526	11.1	14.9
LCP 86-458	10114	207	49.4	2.81	35015	11.9	14.7
LCP 86-463	10211	241	42.3	2.28	37132	12.9	16.8
LCP 86-468	11537	230	49.9	2.47	40611	12.7	16.1
MSD(.05)	3612	17	12.4	0.36	6935	0.8	1.0

* Sampled for breeding purposes only.

Table 6. The 1988 nursery variety trial results from first stubble of the 1986 L series on Commerce silt loam at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	FIBER (%)	JUICE SUCROSE (%)
CP 65-357	13304	246	50.9	2.62	38342	14.9	17.1
CP 70-321	13269	246	52.1	2.67	39250	12.1	16.9
CP 74-383	13988	251	52.7	2.55	41291	13.0	17.2
LCP 86-393	15206	238	61.3	2.68	45148	15.1	16.6
LCP 86-395	15898	259	59.8	2.50	48098	13.0	17.8
LCP 86-402	12897	202	57.7	3.14	36981	11.1	14.5
LCP 86-408	13527	228	54.8	1.94	55585	11.6	16.0
LCP 86-411	10328	233	48.1	2.28	42199	14.9	16.6
LCP 86-412	14099	225	58.0	2.85	41745	12.1	15.6
LCP 86-414	13798	234	57.1	2.67	42653	12.6	16.5
LCP 86-419	17499	270	62.5	2.92	42653	15.2	18.4
LCP 86-420	17263	266	64.1	2.34	54677	14.6	18.2
LCP 86-422*	13462	261	48.4	3.38	28586	14.5	17.8
LCP 86-426	14216	249	55.2	2.24	49232	15.3	17.2
LCP 86-429	13019	213	58.5	2.44	47871	15.2	15.0
LCP 86-434	12042	228	52.2	2.50	42199	14.0	15.9
LCP 86-435	13322	236	57.5	2.90	39931	13.2	16.5
LCP 86-438	13722	243	55.3	3.25	34032	14.4	16.8
LCP 86-447	14277	244	55.6	2.99	37208	17.0	16.6
LCP 86-448*	8275	265	31.1	2.18	28586	13.4	18.1
LCP 86-450	17989	225	78.1	3.68	42426	13.5	15.7
LCP 86-451	13891	235	51.8	2.52	41292	12.5	15.9
LCP 86-453	14607	260	54.9	3.09	36073	12.9	17.8
LCP 86-454	16390	260	62.5	3.09	40384	12.4	17.9
LCP 86-456*	13692	249	54.3	2.40	45149	15.0	17.4
LCP 86-457	17571	216	76.7	2.70	56946	11.4	15.2
LCP 86-458	9951	212	45.4	3.10	29267	12.1	15.0
LCP 86-463	11016	244	43.5	2.22	39023	13.2	16.9
LCP 86-468	12403	243	50.1	2.68	37435	13.7	16.8
MSD(.05)	NS	39	27.5	0.50	15132	1.6	2.0

Planting date: 10/22/86 Harvest date: 11/10/88

* Sampled for breeding purposes only.

Table 7. The 1988 nursery variety trial results from first stubble of the 1986 L series on Sharkey clay at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	FIBER (%)	JUICE SUCROSE (%)
CP 65-357	8477	243	34.0	2.02	34032	13.4	16.8
CP 70-321	10720	232	44.6	2.45	36527	11.7	16.1
CP 74-383	10566	205	50.5	2.12	47644	10.9	14.6
LCP 86-393	8067	207	40.3	2.22	36527	14.3	14.8
LCP 86-395	11860	229	48.1	2.05	46510	11.6	16.0
LCP 86-402	10516	202	49.7	2.99	33124	11.3	14.3
LCP 86-408	13961	214	65.0	2.25	57854	11.8	15.2
LCP 86-411	9439	242	37.9	1.97	38569	13.6	16.8
LCP 86-412	12450	224	55.4	3.19	34939	11.1	15.7
LCP 86-414	9132	218	42.1	2.27	37208	11.9	15.4
LCP 86-419	9284	228	40.3	2.76	29267	13.6	15.9
LCP 86-420	9643	231	41.7	1.76	47417	12.2	16.1
LCP 86-422*	11526	244	45.4	2.86	32216	13.4	16.7
LCP 86-426	9335	230	39.5	2.16	36301	14.0	16.0
LCP 86-429	12527	201	60.9	2.82	42880	14.3	14.2
LCP 86-434	9363	218	41.2	2.19	37208	13.3	15.2
LCP 86-435	11173	228	49.1	2.81	35166	12.2	15.9
LCP 86-438	9316	202	44.6	2.99	29721	12.6	14.4
LCP 86-447	11243	215	51.9	2.70	38342	14.1	15.1
LCP 86-448*	7750	210	35.4	2.04	34712	12.5	14.8
LCP 86-450	6960	182	39.2	2.53	31082	11.5	13.2
LCP 86-451	11857	216	52.0	2.52	41519	12.8	15.1
LCP 86-453	10915	221	46.0	2.72	33805	11.8	15.5
LCP 86-454	16584	238	68.2	2.75	49686	11.6	16.5
LCP 86-456*	11890	245	47.9	2.15	44695	14.4	16.9
LCP 86-457	13449	202	66.7	2.24	59668	10.9	14.2
LCP 86-458	7882	188	43.4	2.45	34485	11.4	13.6
LCP 86-463	10752	225	47.1	2.43	38796	12.6	15.8
LCP 86-468	10883	211	50.7	2.46	41292	12.3	14.8
MSD(.05)	5028	54	17.6	0.50	8743	1.2	3.2

Planting date: 10/21/86 Harvest date: 11/07/88

* Sampled for breeding purposes only.

Table 8. The 1988 nursery variety trial results from first stubble of the 1986 L series on Baldwin silty clay loam at the Iberia Research Station.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	FIBER (%)	JUICE SUCROSE (%)
CP 65-357	9217	240	40.5	2.43	31990	13.3	16.7
CP 70-321	8109	247	34.5	2.07	33351	11.0	17.1
CP 74-383	11640	222	56.3	2.41	46737	11.1	15.7
LCP 86-393	13866	245	58.8	2.56	45829	14.7	17.0
LCP 86-395	10429	244	45.0	1.76	51274	11.2	17.0
LCP 86-402	12628	212	61.7	2.95	41972	11.3	15.1
LCP 86-408	14990	233	66.4	2.38	55585	11.3	16.3
LCP 86-411	11217	232	51.5	2.17	47190	15.0	16.3
LCP 86-412	15004	242	65.1	2.71	48098	10.4	16.8
LCP 86-414	7331	202	36.7	1.67	44695	11.7	14.7
LCP 86-419	10813	256	47.3	2.75	34485	13.9	17.6
LCP 86-420	12122	273	46.8	2.19	42653	13.3	18.9
LCP 86-422*	10827	256	45.4	2.82	32443	12.8	17.6
LCP 86-426	10424	242	45.3	1.83	49459	13.6	16.8
LCP 86-429	11180	200	58.6	2.37	49459	14.1	14.3
LCP 86-434	10273	233	47.8	2.35	40838	13.9	16.2
LCP 86-435	9666	228	43.4	2.24	38796	11.6	16.0
LCP 86-438	9898	217	47.8	2.76	34712	12.6	15.3
LCP 86-447	12266	232	55.4	2.94	37662	15.4	16.2
LCP 86-448*	8314	264	32.9	1.96	33805	12.6	18.2
LCP 86-450	9292	214	46.6	2.57	36073	11.5	15.1
LCP 86-451	12794	256	51.8	2.02	51501	13.6	17.5
LCP 86-453	13334	264	52.6	2.84	37662	11.5	18.2
LCP 86-454	12586	251	52.1	2.73	38342	11.8	17.4
LCP 86-456*	11488	264	45.0	1.58	56492	15.1	18.2
LCP 86-457	11725	217	57.4	2.44	46964	11.0	15.3
LCP 86-458	12509	221	59.5	2.89	41292	12.3	15.6
LCP 86-463	8866	255	36.4	2.19	33578	13.0	17.7
LCP 86-468	11326	237	49.0	2.27	43107	12.1	16.6
MSD(.05)	4992	24	20.4	0.70	10788	1.4	1.4

Planting date: 10/21/86 Harvest date: 11/16/88

* Sampled for breeding purposes only.

Table 9. The 1988 nursery variety trial means from plant cane of the 1987 L series over three locations.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	FIBER (%)	JUICE SUCROSE (%)
CP 65-357	5762	256	22.4	2.18	20543	13.4	17.6
CP 70-321	8444	263	31.2	2.53	24833	12.8	18.0
CP 74-383	8978	233	37.0	2.59	25575	12.1	16.2
LCP 87-001	8974	216	39.2	2.42	29393	12.7	15.2
LCP 87-002	7262	225	31.1	2.35	25823	15.7	15.8
LCP 87-003	9014	201	44.4	2.81	31226	12.5	14.3
LCP 87-004	7235	230	30.1	1.99	29824	12.8	16.0
LCP 87-005	9303	227	38.9	2.59	29535	14.5	15.8
LCP 87-010	8676	229	37.3	2.35	32464	13.8	16.0
LCP 87-012	9567	198	46.2	2.86	29040	13.7	14.2
LCP 87-013	8708	254	33.4	2.37	28339	15.7	17.5
LCP 87-014	8194	217	36.0	2.47	27514	13.2	15.3
LCP 87-017	9882	232	41.5	2.64	32258	13.7	16.1
LCP 87-018	8151	234	33.7	1.90	38362	12.2	16.3
LCP 87-019	7276	228	29.1	2.21	23884	12.5	15.9
LCP 87-020	8630	226	37.6	2.25	34939	11.9	15.8
LCP 87-023	9428	248	37.0	2.46	28504	13.6	17.0
LCP 87-024	8700	190	42.3	3.01	25823	12.1	13.8
LCP 87-025	6415	226	26.1	1.99	24214	13.3	15.9
LCP 87-472	9760	216	45.0	2.50	35558	13.6	15.2
LCP 87-473	8749	245	36.1	2.59	27596	14.4	16.8
LCP 87-474	7613	208	35.9	2.25	31061	15.6	14.8
LCP 87-477	9000	221	40.9	3.12	24296	11.4	15.6
LCP 87-478	7379	216	34.0	2.03	34238	11.5	15.1
LCP 87-479	11071	216	47.4	2.70	33413	13.3	15.1
LCP 87-483	6539	245	24.6	1.47	30814	11.5	17.0
LCP 87-486	10156	235	41.4	2.58	29998	14.6	16.3
LCP 87-490	7681	241	30.2	2.31	24956	14.3	16.7
LCP 87-491	9115	236	37.0	2.04	34361	13.0	16.4
LCP 87-492	7724	237	30.8	2.19	29205	13.7	16.4
LCP 87-494	9513	226	40.3	2.76	26730	13.1	15.8
LCP 87-495	8959	232	36.7	2.31	30278	11.0	16.2
LCP 87-496	11687	235	47.4	2.65	36011	13.9	16.2
LCP 87-497	5979	235	24.1	2.01	22083	11.5	16.4
LCP 87-499	7467	258	27.9	2.58	18452	13.3	17.7
MSD(.05)	2881	17	10.4	0.39	6774	1.6	1.0

Table 10. The 1988 nursery variety trial results from plant cane of the 1987 L series on Commerce silt loam at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	FIBER (%)	JUICE SUCROSE (%)
CP 65-357	8702	248	36.0	2.60	28132	14.3	37.2
CP 70-321	10032	273	37.0	2.52	28020	13.8	18.5
CP 74-383	11643	238	47.7	3.00	31082	12.2	16.5
LCP 87-001	11064	236	46.9	2.52	32217	.	16.2
LCP 87-002	8145	228	35.6	2.04	30061	16.3	15.9
LCP 87-003	13231	189	67.8	3.15	42880	11.6	13.7
LCP 87-004	10060	245	40.7	2.12	38909	14.0	16.9
LCP 87-005	12580	251	49.2	2.80	35053	16.6	17.2
LCP 87-010	10640	234	46.3	2.27	44127	14.7	16.2
LCP 87-012	13611	216	63.1	2.99	37662	.	15.2
LCP 87-013	12062	255	45.5	2.46	37321	15.3	17.4
LCP 87-014	12849	221	55.3	2.89	37321	14.3	15.4
LCP 87-017	11457	250	45.2	2.27	40271	14.1	17.2
LCP 87-018	13603	248	50.7	2.15	45375	11.6	17.1
LCP 87-019	11365	254	43.1	2.47	32897	13.6	17.4
LCP 87-020	8982	223	43.6	2.07	48779	12.7	15.6
LCP 87-023	10896	245	44.5	2.31	39136	14.5	16.8
LCP 87-024	12949	204	61.2	3.26	36527	13.5	14.6
LCP 87-025	9925	212	40.1	2.49	28132	12.7	15.0
LCP 87-472	11429	225	50.9	2.73	37888	14.3	15.8
LCP 87-473	14130	259	52.9	3.11	31422	15.4	17.7
LCP 87-474	10689	206	50.4	2.43	45602	15.1	14.7
LCP 87-477	11405	233	49.4	3.62	26091	11.8	16.3
LCP 87-478	9569	219	43.8	2.42	37548	11.5	15.2
LCP 87-479	15462	226	64.3	3.08	40271	15.0	15.7
LCP 87-483	11131	261	40.7	1.89	37434	13.1	17.8
LCP 87-486	11799	241	49.0	2.70	35847	.	16.6
LCP 87-490	10348	240	43.1	2.29	34485	.	16.6
LCP 87-491	12268	226	51.9	2.40	42539	13.5	15.6
LCP 87-492	9221	242	35.7	2.46	30061	14.9	16.6
LCP 87-494	12563	231	51.2	2.88	34939	13.3	16.1
LCP 87-495	14569	250	58.0	2.81	40838	12.7	17.3
LCP 87-496	15052	242	56.8	2.69	40611	15.3	16.6
LCP 87-497	8098	247	32.8	2.16	29267	.	17.0
LCP 87-499	10837	279	38.8	2.55	26091	.	19.0
MSD(.05)	5595	44	15.5	0.72	17595		2.6

Planting date: 10/19/87 Harvest date: 11/29/88

Table 11. The 1988 nursery variety trial results from plant cane of the 1987 L series on Sharkey clay at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	FIBER (%)	JUICE SUCROSE (%)
CP 65-357	4303	251	16.2	2.10	16449	13.2	17.4
CP 70-321	7884	243	30.7	2.63	25297	12.9	16.7
CP 74-383	6179	225	26.1	2.10	19511	12.3	15.6
LCP 87-001	7770	209	34.9	2.46	25070	13.1	14.8
LCP 87-002	5080	212	23.0	2.28	20533	15.4	15.0
LCP 87-003	6254	207	30.4	2.44	24956	13.0	14.7
LCP 87-004	5327	200	24.7	2.06	22461	12.2	14.3
LCP 87-005	7633	208	33.6	2.39	25864	12.9	14.6
LCP 87-010	7150	227	30.6	2.46	21894	13.4	15.8
LCP 87-012	6429	190	33.0	2.84	20986	14.0	13.7
LCP 87-013	5876	249	23.7	2.24	20532	16.5	17.3
LCP 87-014	5223	208	24.4	2.29	19738	12.6	14.7
LCP 87-017	7542	215	33.7	2.90	22461	13.3	15.1
LCP 87-018	7306	231	31.0	1.72	38002	12.7	16.1
LCP 87-019	3342	207	14.3	1.91	10663	11.4	14.6
LCP 87-020	8984	227	36.8	2.40	27452	11.8	15.9
LCP 87-023	6538	251	26.0	2.34	17810	14.2	17.3
LCP 87-024	5732	171	30.5	2.89	15541	11.0	12.7
LCP 87-025	6307	231	25.5	1.88	22688	13.8	16.3
LCP 87-472	8423	215	39.7	2.25	33918	13.9	15.1
LCP 87-473	5821	247	24.6	2.17	23141	14.1	17.0
LCP 87-474	5377	212	25.4	2.18	18377	16.7	15.1
LCP 87-477	6664	218	31.2	3.04	17356	11.4	15.4
LCP 87-478	6925	216	32.2	1.78	38115	12.1	15.1
LCP 87-479	7899	206	34.5	2.49	25524	12.0	14.5
LCP 87-483	5539	224	22.2	1.51	24389	10.9	15.7
LCP 87-486	9845	238	38.5	2.69	24616	15.0	16.5
LCP 87-490	6901	227	28.2	2.30	22575	14.1	15.9
LCP 87-491	7655	232	31.5	1.93	29154	12.8	16.2
LCP 87-492	8143	230	33.6	2.17	32330	13.1	16.0
LCP 87-494	7600	227	32.0	2.72	17016	13.3	15.8
LCP 87-495	4275	207	19.6	2.03	19625	9.7	14.8
LCP 87-496	10312	233	43.1	2.63	30628	13.0	16.1
LCP 87-497	3118	224	13.5	1.75	13839	11.2	15.7
LCP 87-499	4706	251	18.2	2.32	12818	13.3	17.3
MSD(.05)	6455	47	26.8	0.60	NS		3.0

Planting date: 10/14/87 Harvest date: 11/29/88

Table 12. The 1988 nursery variety trial results from plant cane of the 1987 L series on Baldwin silty clay loam at the Iberia Research Station.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	FIBER (%)	JUICE SUCROSE (%)
CP 65-357	4281	273	15.1	1.84	15881	12.6	18.7
CP 70-321	7417	277	25.8	2.44	19965	11.2	18.9
CP 74-383	9114	238	37.2	2.67	26318	11.7	16.5
LCP 87-001	9133	219	39.8	2.33	33275	11.9	15.4
LCP 87-002	9002	239	37.0	2.59	27225	15.1	16.7
LCP 87-003	7558	207	35.1	2.86	24049	13.2	14.8
LCP 87-004	6320	251	24.8	1.78	27528	11.8	17.2
LCP 87-005	7698	219	33.8	2.59	27074	13.7	15.4
LCP 87-010	8239	227	34.9	2.33	31006	13.2	15.9
LCP 87-012	10684	202	51.0	2.83	34031	13.2	14.5
LCP 87-013	8186	261	31.0	2.42	26772	15.3	17.9
LCP 87-014	6510	224	28.3	2.24	24805	12.7	15.8
LCP 87-017	10647	230	45.5	2.76	34637	13.6	16.2
LCP 87-018	6271	223	27.9	1.95	29494	12.4	15.7
LCP 87-019	9165	232	37.0	2.37	29494	12.5	16.1
LCP 87-020	7925	230	32.4	2.28	26469	10.9	16.1
LCP 87-023	10852	248	40.6	2.74	28587	11.4	17.1
LCP 87-024	7421	198	35.3	2.89	25259	11.6	14.4
LCP 87-025	4770	234	19.7	1.86	21024	13.6	16.4
LCP 87-472	9429	206	44.3	2.53	34637	12.3	14.7
LCP 87-473	8986	227	39.3	2.75	28435	13.5	15.8
LCP 87-474	6774	204	31.8	2.15	28586	14.7	14.8
LCP 87-477	8932	210	42.1	2.72	31158	10.8	15.1
LCP 87-478	5642	213	26.1	1.90	24654	10.7	14.9
LCP 87-479	9851	216	43.4	2.54	34788	12.8	15.1
LCP 87-483	5245	257	19.1	1.23	30553	9.9	17.8
LCP 87-486	9645	228	40.5	2.43	33275	13.8	15.9
LCP 87-490	7128	260	25.9	2.35	21780	14.5	17.9
LCP 87-491	7424	257	27.6	1.79	30401	12.4	17.7
LCP 87-492	6556	242	25.5	2.09	23898	12.8	16.7
LCP 87-494	8375	218	37.8	2.70	28738	12.6	15.4
LCP 87-495	8033	241	32.6	2.09	30401	10.6	16.8
LCP 87-496	11380	231	47.1	2.64	37057	13.3	16.0
LCP 87-497	7782	246	30.3	2.19	28284	11.9	17.2
LCP 87-499	8545	260	32.2	2.86	20872	13.3	17.8
MSD(.05)	4304	22	20.2	0.62	18008		1.3

Planting date: 10/16/87 Harvest date: 11/16/88

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1988 LOUISIANA (L) INFIELD VARIETY TRIALS

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In the Louisiana (L) Sugarcane Variety Improvement Program, experimental varieties are planted in Infield Variety Trials from the year after number assignment (nursery stage) through introduction to outfield test locations. These trials are the first in the selection program from which samples are cut by machine.

Normal cultural practices were used in infield trials in 1988. In early spring, 2,4-D was applied to remove winter weeds and metribuzin was applied after off-barring in March. Fields were fertilized in the latter part of April. Layby was completed for all infield trials by June 14, 1988. A pre-emergence herbicide (Atrazine) was applied at layby. Sugarcane borer populations were checked on a weekly basis. The infield plots were sprayed with azinphos methyl (Guthion) once during the growing season.

Replicated tests were planted in Commerce silt loam and Sharkey clay soils on the St. Gabriel Research Station on September 15 and 31 (Table 2). The plot size was 16 feet by three rows on six foot centers. Randomized complete block designs with two replications were used in all trials and included three commercial check varieties: CP 65-357, CP 70-321, and CP 74-383.

Plots were harvested from October 10 through December 1, 1988 (Table 2). Plots were mechanically cut and plot heaps were weighed with a tractor-mounted hydraulic weigh rig. Ten-stalk samples were used to estimate stalk weight and obtain a juice sample for analysis. Crusher juice was analyzed for sucrose by polarization and Brix by refractometer. Theoretical recoverable sugar (TRS) was calculated using Brix and sucrose values according to the methods described by Legendre and Henderson (1972). Sugar yield was estimated as the product of cane yield and TRS.

The percent of the stalks broken by the harvester was estimated for the plantcane trials of the 1984 and 1985 assignment series grown on Commerce silt loam and the 1986 assignment series grown on both the Commerce silt loam and the Sharkey clay. Prior to weighing, 50 stalk samples were examined for damage to estimate percent broken stalks.

Analysis of variance was performed for each crop and assignment series by and over soil type when appropriate (Tables 3 through 25). Minimum significant differences (MSD) were calculated by the Waller-Duncan multiple range test (SAS, 1985).

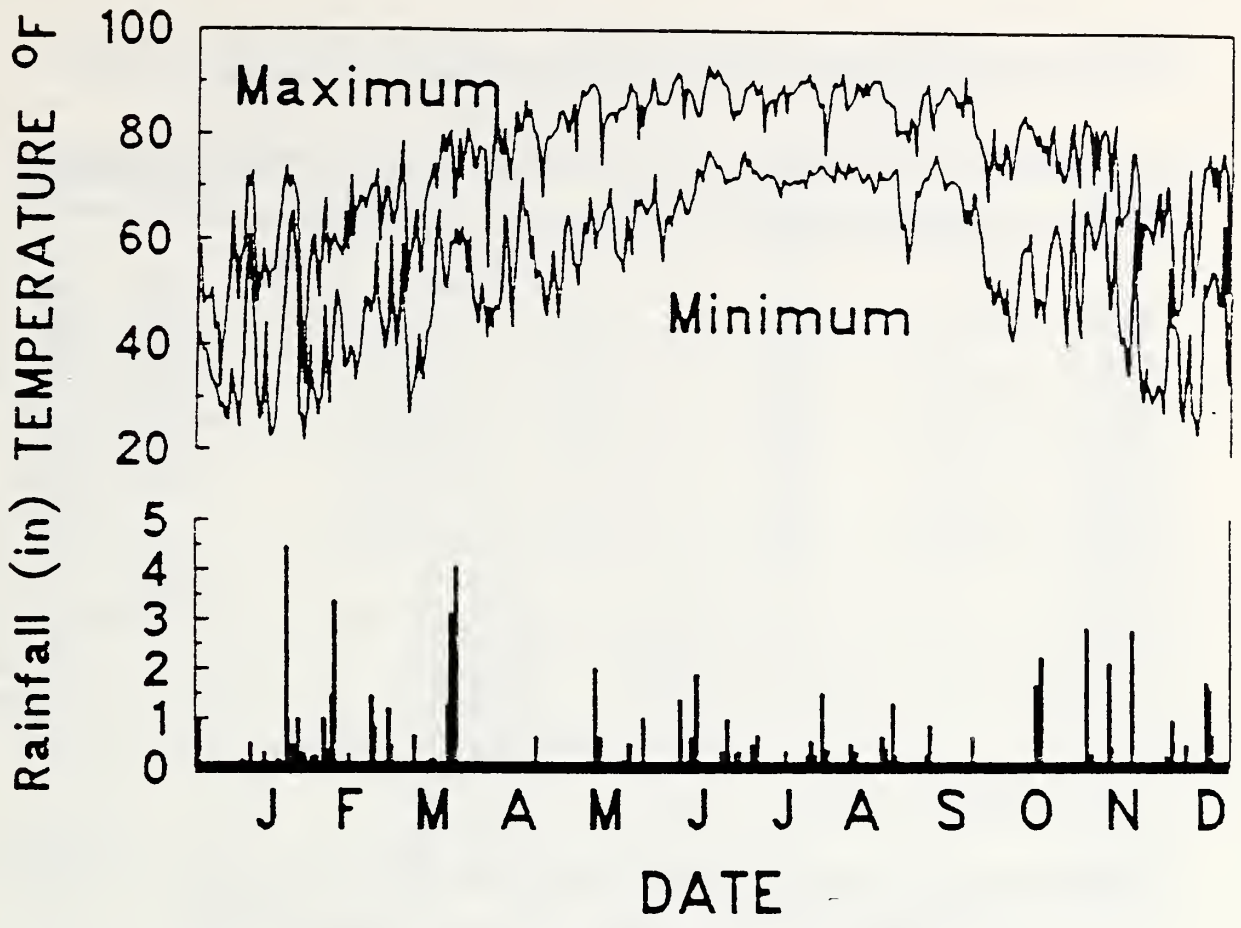

Fig. 1 Graphic summary of 1988 climatic data for St. Gabriel, LA.

Table 1. Summary of 1988 climatic data for St. Gabriel, LA [a]

Month	Mean Temp	Mean Temp	Max Temp	Min Total	Mean 24hr	Month Total	Max Total	Year Total	Rainy Days
	---------- °F ----------				--------- inches ----------				%
JAN	55.1	35.0	73.9	22.5	45.1	2.16	1.00	2.16	65
PEP	60.4	40.0	72.3	21.9	50.2	13.95	4.47	16.11	45
MAR	68.1	47.3	81.0	27.0	57.7	9.43	3.10	25.54	32
APR	77.4	54.6	87.3	41.5	66.0	5.69	4.05	31.23	27
MAY	84.1	58.7	90.0	45.3	71.4	3.00	2.00	34.23	19
JUN	87.7	67.8	93.7	56.1	77.8	5.71	1.88	39.94	30
JUL	87.8	72.5	93.0	68.2	80.2	3.53	0.97	43.47	32
AUG	88.3	72.8	92.3	69.3	80.6	4.66	1.50	48.13	42
SEP	85.3	69.4	91.9	56.1	77.4	3.30	1.30	51.43	23
OCT	78.0	54.1	84.6	41.4	66.0	4.54	2.22	55.97	13
NOV	74.3	51.8	84.0	30.2	63.1	8.33	2.80	64.30	17
DEC	65.4	41.0	77.9	24.1	53.3	5.81	1.71	70.11	26
Mean	76.0	55.4	93.7	21.9	65.8	70.11	4.47	70.11	31

a Temperature data from LSU Ben Hur Research Station. All data from the "Preliminary Climate Data" of the National Weather Service and Louisiana Office of State Climatology.

Table 2. Planting date and harvest dates of infield tests harvested in 1988.

Assignment Series	Reps	Soil* Texture	Planting Date	Harvest Dates 1986	1987	1988
1982 L & CP	2	C.s.l.	9/18/85	12/01	11/04	10/26
1982 L & CP	2	S.c.	9/18/85	12/12	10/09	10/10
1983 L & CP	2	C.s.l.	9/23/85	12/03	11/05	10/26
1983 L	2	S.c.	10/07/85	12/04	11/03	10/10
1983 L & CP	2	C.s.l.	9/19/86		11/30	10/28
1983 L & CP	2	S.c.	8/28/86		11/20	11/02
1984 L	2	C.s.l.	9/26/85	12/10	11/05	10/11
1984 L & CP	2	S.c.	9/25/86		11/20	10/26
1984 L & CP	2	C.s.l.	9/04/87			11/22
1984 L & CP	2	S.c.	9/09/87			11/30
1985 L	2	C.s.l.	9/26/86		12/01	11/03
1985 L	2	S.c.	9/18/86		11/06	11/02
1985 L	2	C.s.l.	9/04/87			11/15
1985 L	2	S.c.	9/11/87			11/30
1986 L	2	C.s.l.	9/18/87			11/28
1986 L	2	S.c.	9/15/87			12/01
1985 & 1986 L & CP	1	C.s.l.	9/15/88			
1985 & 1986 L & CP	1	S.c.	9/31/88			
1987 L	1	C.s.l.	9/15/88			
1987 L	1	S.c.	9/31/88			

* C.s.l. = Commerce silt loam S.c. = Sharkey clay

Table 3. The 1988 infield variety trial means from second stubble of the 1982 L & CP series over soil types at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	5730	197	27.4	1.89	28465
CP 70-321	7699	227	33.1	1.87	35332
CP 74-383	8979	216	41.1	1.92	42315
LCP 82-046*	6722	174	31.6	2.08	29187
LCP 82-058*	7571	220	33.9	1.77	38067
LCP 82-089	8020	217	36.5	1.83	39600
CP 82-513	6550	209	29.8	1.99	30746
CP 82-550	7877	245	31.6	1.55	40450
CP 82-551	8121	223	35.5	1.82	38196
MSD(.05)	NS	NS	NS	NS	NS

* Sampled for breeding purposes only.

Table 4. The 1988 infield variety trial results from second stubble of the 1982 L & CP series on Commerce silt loam soil at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	8544	231	37.0	2.25	32918
CP 70-321	10244	254	40.5	1.93	42069
CP 74-383	11582	228	51.1	2.20	46987
LCP 82-046*	12253	230	53.2	2.23	47896
LCP 82-058*	9430	246	38.4	1.88	40685
LCP 82-089	10282	235	43.9	1.98	44473
CP 82-513	9854	236	41.8	1.97	43806
CP 82-550	10088	268	37.6	1.68	45031
CP 82-551	11054	246	45.0	2.02	44559
MSD(.05)	NS	NS	10.1	NS	NS

Planting date: 9/18/85 Harvest date: 10/26/88

* Sampled for breeding purposes only.

Table 5. The 1988 infield variety trial results from second stubble of the 1982 L & CP series on Sharkey clay soil at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	2915	164	17.9	1.53	24012
CP 70-321	5155	200	25.8	1.81	28595
CP 74-383	6375	204	31.2	1.65	37643
LCP 82-046*	1191	119	10.1	1.94	10479
LCP 82-058*	5712	193	29.4	1.67	35449
LCP 82-089	5758	199	29.1	1.68	34727
CP 82-513	3245	183	17.8	2.01	17687
CP 82-550	5667	221	25.7	1.43	35869
CP 82-551	5189	201	25.9	1.62	31834
MSD(.05)	1541	25	7.6	NS	9376

Planting date: 9/18/85 Harvest date: 10/10/88

* Sampled for breeding purposes only.

Table 6. The 1988 infield variety trial means from second stubble of the 1983 L series over soil types at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	6421	227	27.8	1.96	28379
CP 70-321	7019	232	30.4	1.97	31072
CP 74-383	9838	227	42.6	2.00	42803
LCP 83-137	7591	204	36.9	1.70	43760
LCP 83-149	7868	240	32.1	1.97	32734
LCP 83-153	9404	221	41.5	1.87	44120
MSD(.05)	NS	NS	10.1	0.17	10701

Table 7. The 1988 infield variety trial results from second stubble of the 1983 L & CP series on Commerce silt loam soil at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	7837	253	30.9	2.11	29303
CP 70-321	8165	275	29.7	2.09	28662
CP 74-383	12559	263	47.9	2.08	46212
LCP 83-137	9011	227	39.7	1.87	43010
LCP 83-149	9955	281	35.4	2.16	32980
LCP 83-153	12310	255	48.2	1.98	48899
CP 83-606*	10769	266	40.5	2.21	37039
CP 83-625	10725	253	42.4	1.76	48545
CP 83-644	11810	269	43.9	2.14	41114
MSD(.05)	2933	22	8.4	NS	13646

Planting date: 9/23/85 Harvest date: 10/26/88

* Sampled for breeding purposes only.

Table 8. The 1988 infield variety trial results from second stubble of the 1983 L series on Sharkey clay soil at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	5005	202	24.8	1.81	27455
CP 70-321	5874	189	31.0	1.86	33483
CP 74-383	7117	192	37.3	1.93	39395
LCP 83-137	6171	181	34.0	1.53	44511
LCP 83-149	5780	199	28.9	1.78	32488
LCP 83-153	6498	187	34.8	1.77	39342
MSD(.05)	NS	NS	7.7	NS	7455

Planting date: 10/7/85 Harvest date: 10/10/88

Table 9. The 1988 infield variety trial means from first stubble of the 1983 L & CP series over soil types at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	8883	239	37.3	2.25	33646
CP 70-321	9784	250	39.0	2.48	31331
CP 74-383	10213	234	43.4	2.22	38983
LCP 83-137	10135	222	45.8	1.92	47622
LCP 83-149	10739	258	41.5	2.32	35768
LCP 83-153	11823	259	45.7	2.53	36106
CP 83-606*	10377	258	40.2	2.84	28478
CP 83-625	10277	257	39.8	2.19	36440
CP 83-644	11567	267	43.4	2.21	39618
MSD(.05)	NS	26	NS	0.37	9590

* Sampled for breeding purposes only.

Table 10. The 1988 infield variety trial results from first stubble of the 1983 L & CP series on Commerce silt loam soil at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	9203	241	38.2	2.54	30161
CP 70-321	11219	256	43.9	2.60	33775
CP 74-383	11915	248	48.0	2.36	40678
LCP 83-137	10785	225	48.1	1.98	48653
LCP 83-149	12114	270	44.8	2.52	35536
LCP 83-153	12808	273	46.9	2.48	37741
CP 83-606*	10643	254	41.9	2.90	28885
CP 83-625	12833	260	49.4	2.36	42585
CP 83-644	11984	268	44.6	2.34	38110
MSD(.05)	NS	NS	NS	.41	7738

Planting date: 9/19/86 Harvest date: 10/28/88

* Sampled for breeding purposes only.

Table 11. The 1988 infield variety trial results from first stubble of the 1983 L & CP series on Sharkey clay soil at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	8562	236	36.3	1.96	37132
CP 70-321	8349	244	34.1	2.37	28888
CP 74-383	8512	220	38.8	2.09	37289
LCP 83-137	9485	219	43.5	1.86	46592
LCP 83-149	9365	245	38.2	2.12	36000
LCP 83-153	10838	244	44.4	2.58	34472
CP 83-606*	10111	262	38.6	2.79	28072
CP 83-625	7722	255	30.3	2.03	30295
CP 83-644	11151	265	42.2	2.07	41127
MSD(.05)	NS	31	NS	NS	NS

Planting date: 8/28/86 Harvest date: 11/2/88

* Sampled for breeding purposes only.

Table 12. The 1988 infield variety trial results from second stubble of the 1984 L series on Commerce silt loam soil at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	5931	205	28.9	2.00	29064
CP 70-321	6791	211	32.2	1.92	33933
CP 74-383	7979	203	39.3	2.20	35881
LCP 84-222	8040	202	39.7	2.13	37486
L 84-290	7115	227	31.4	1.76	35880
MSD(.05)	465	NS	4.0	NS	NS

Planting date: 9/26/85 Harvest date: 10/11/88

Table 13. The 1988 infield variety trial results from first stubble of the 1984 L & CP series on Sharkey clay soil at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	7316	211	34.8	2.18	31878
CP 70-321	8857	253	35.1	2.23	31582
CP 74-383	8298	215	38.5	2.18	35295
LCP 84-222	6245	203	31.1	2.07	29787
L 84-290	8201	254	32.4	1.66	39101
CP 84-730	9476	258	36.7	2.58	28450
CP 84-738	7988	282	28.3	2.04	27818
CP 84-746	8751	245	35.7	1.89	38284
MSD(.05)	NS	26	NS	0.47	NS

Planting date: 9/25/86 Harvest date: 10/26/88

Table 14. The 1988 infield variety trial means from plant cane of the 1984 L & CP series over soil types at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	8230	263	31.3	2.40	26228
CP 70-321	8553	268	31.9	2.43	26427
CP 74-383	7803	246	31.5	2.30	26988
LCP 84-222	5545	222	24.5	2.01	22414
L 84-290	8833	252	35.0	2.04	34014
CP 84-730	9946	279	35.5	2.68	26658
CP 84-738	8311	288	28.8	2.20	26161
CP 84-746	4625	258	17.5	2.42	14426
MSD(.05)	NS	24	NS	NS	9669

Table 15. The 1988 infield variety trial results from plant cane of the 1984 L & CP series on Commerce silt loam soil at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	BROKEN STALKS (%)
CP 65-357	9174	273	33.7	2.52	26741	24
CP 70-321	10529	268	39.3	2.56	30626	56
CP 74-383	9986	247	40.2	2.50	32171	48
LCP 84-222	8962	230	39.0	2.80	27914	44
L 84-290	10531	252	41.7	2.22	37705	14
CP 84-730	11286	292	38.6	3.01	25743	56
CP 84-738	9581	305	31.4	2.33	26930	17
CP 84-746	4624	272	17.0	2.49	13691	33
MSD(.05)	2649	36	8.5	0.35	8142	17

Planting date: 9/4/87 Harvest date: 11/22/88

Table 16. The 1988 infield variety trial results from plant cane of the 1984 L & CP series on Sharkey clay soil at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	7285	253	28.9	2.29	25715
CP 70-321	6577	267	24.6	2.30	22228
CP 74-383	5621	246	22.9	2.10	21805
LCP 84-222	2127	214	10.0	1.22	16914
L 84-290	7135	252	28.4	1.87	30324
CP 84-730	8607	267	32.3	2.35	27573
CP 84-738	7041	270	26.1	2.06	25393
CP 84-746	4626	244	18.6	2.36	15897
MSD(.05)	1250	34	5.4	0.70	9165

Planting date: 9/9/87 Harvest date: 11/30/88

Table 17. The 1988 infield variety trial means from first stubble of the 1985 L series over soil types at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	7248	254	28.6	2.29	25079
CP 70-321	7701	271	27.7	2.34	23132
CP 74-383	8842	258	32.0	2.28	29917
LCP 85-298	9935	251	39.6	1.86	43169
LCP 85-307*	7698	286	26.9	1.78	30508
LCP 85-316*	9420	283	33.3	2.24	29859
LCP 85-336	11194	252	44.8	2.24	40266
LCP 85-341*	7487	264	28.4	1.64	34844
LCP 85-352	9324	243	38.4	2.19	35493
LCP 85-376	10131	263	38.8	2.14	36230
LCP 85-384	12775	266	48.1	2.03	47748
MSD(.05)	3235	19	11.0	.22	8857

* Sampled for breeding purposes only.

Table 18. The 1988 infield variety trial results from first stubble of the 1985 L series on Commerce silt loam soil at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	7557	262	28.9	2.46	23427
CP 70-321	10557	289	36.4	2.62	27836
CP 74-383	9727	262	37.1	2.44	30415
LCP 85-298	10059	251	40.1	2.03	39491
LCP 85-307*	8510	291	29.3	1.93	30891
LCP 85-316*	9458	290	32.7	2.34	28230
LCP 85-336	10517	259	40.7	2.34	34813
LCP 85-341*	7907	274	28.7	1.81	31516
LCP 85-352	9564	246	38.9	2.46	31812
LCP 85-376	10108	259	39.4	2.22	35587
LCP 85-384	13029	267	49.0	2.12	46817
MSD(.05)	NS	30	NS	0.36	NS

Planting date: 9/26/86 Harvest date: 11/3/88

* Sampled for breeding purposes only.

Table 19. The 1988 infield variety trial results from first stubble of the 1985 L series on Sharkey clay soil at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	6939	246	28.2	2.11	26731
CP 70-321	4845	254	19.0	2.06	18428
CP 74-383	7073	251	27.0	1.95	28923
LCP 85-298	9812	251	39.1	1.68	46847
LCP 85-307*	6886	280	24.6	1.64	30125
LCP 85-316*	9382	277	33.9	2.15	31487
LCP 85-336	11871	245	48.9	2.14	45719
LCP 85-341*	7068	254	28.0	1.47	38172
LCP 85-352	9085	240	37.8	1.93	39174
LCP 85-376	10155	267	38.2	2.07	36873
LCP 85-384	12521	265	47.3	1.95	48680
MSD(.05)	1886	NS	8.3	NS	7781

Planting date: 9/18/86 Harvest date: 11/2/88

* Sampled for breeding purposes only.

Table 20. The 1988 infield variety trial means from plant cane of the 1985 L series over soil types at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	6729	276	24.5	2.18	22790
CP 70-321	7708	269	28.6	2.33	25630
CP 74-383	7602	249	30.1	2.40	24830
LCP 85-298	7683	240	31.6	2.08	30015
LCP 85-307*	7170	291	24.7	1.95	25315
LCP 85-316*	7065	281	24.8	2.21	21750
LCP 85-336	9319	252	37.0	2.36	31305
LCP 85-352	6685	256	26.1	2.06	25419
LCP 85-376	9499	275	34.6	2.37	29451
LCP 85-384	9707	273	35.6	1.97	36903
MSD(.05)	NS	13	NS	NS	NS

* Sampled for breeding purposes only.

Table 21. The 1988 infield variety trial results from plant cane of the 1985 L series on Sharkey clay soil at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)
CP 65-357	6739	261	25.8	2.02	25949
CP 70-321	7071	253	28.1	1.85	30448
CP 74-383	5520	233	23.7	2.18	21718
LCP 85-298	5810	225	25.7	1.90	27048
LCP 85-307*	6371	285	22.4	1.75	25664
LCP 85-316*	4923	270	18.0	1.93	18108
LCP 85-336	9055	244	37.1	2.28	32601
LCP 85-352	6363	240	26.5	1.93	27814
LCP 85-376	8672	262	33.2	2.10	31587
LCP 85-384	9827	267	37.0	1.86	40361
MSD(.05)	3387	23	12.8	NS	NS

Planting date: 9/11/87 Harvest date: 11/30/88

* Sampled for breeding purposes only.

Table 22. The 1988 infield variety trial results from plant cane of the 1985 L & CP series on Commerce silt loam soil at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	BROKEN STALKS (%)
CP 65-357	6719	292	23.1	2.35	19632	11
CP 70-321	8345	286	29.2	2.81	20812	31
CP 74-383	9684	265	36.6	2.62	27943	20
LCP 85-298	9556	255	37.4	2.27	32983	19
LCP 85-307*	7970	296	27.0	2.16	24966	31
LCP 85-316*	9208	292	31.5	2.50	25393	19
LCP 85-336	9583	261	36.8	2.45	30009	19
LCP 85-352	7007	272	25.7	2.20	23023	25
LCP 85-376	10325	288	35.9	2.63	27315	16
LCP 85-384	9588	280	34.3	2.09	33446	37
CP 85-800	10932	265	41.6	2.89	29302	36
CP 85-803	9799	272	36.1	2.53	28606	35
CP 85-830	8351	285	29.3	2.45	24062	15
CP 85-845	8665	261	33.2	2.21	30208	33
CP 85-859	7569	305	24.8	2.47	20081	37
CP 85-860*	7294	237	30.8	3.21	19297	23
CP 85-866*	7658	283	27.2	2.39	23400	36
MSD(.05)	2421	18	9.2	0.53	8340	NS

Planting date: 9/4/87 Harvest date: 11/15/88

* Sampled for breeding purposes only.

Table 23. The 1988 infield variety trial means from plant cane of the 1986 L series over soil types at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	BROKEN STALKS (%)
CP 65-357	7249	261	27.7	2.60	21285	16
CP 70-321	8604	265	32.5	2.45	26544	28
CP 74-383	8883	238	37.0	2.55	28921	27
LCP 86-393	9121	246	37.2	2.33	31972	24
LCP 86-395	8050	264	30.3	2.47	24517	50
LCP 86-402	9851	237	41.6	3.19	25953	53
LCP 86-408	8314	240	34.6	2.49	27848	39
LCP 86-411	8007	270	29.4	2.24	26252	28
LCP 86-412	8065	254	31.6	2.94	21546	40
LCP 86-414	5967	229	26.1	2.92	17911	21
LCP 86-419	10006	265	37.7	2.55	29614	35
LCP 86-420	9206	258	35.8	2.04	34840	43
LCP 86-422*	6424	266	24.0	2.94	16238	38
LCP 86-426	8261	247	33.3	1.91	35181	20
LCP 86-429	9076	209	43.3	2.60	33685	22
LCP 86-434	7937	250	31.8	2.43	26201	26
LCP 86-435	8424	251	33.6	2.88	23321	17
LCP 86-438	7209	232	31.2	3.04	20512	26
LCP 86-447	9816	246	39.8	2.61	30423	38
LCP 86-450	8657	229	37.8	3.00	25146	36
LCP 86-451	7541	258	29.3	2.67	22833	33
LCP 86-453	8798	265	33.1	2.98	22273	27
LCP 86-454	10966	253	43.5	3.15	27776	33
LCP 86-456*	8194	284	28.9	1.96	30305	22
LCP 86-457	9253	237	39.1	2.14	36552	46
LCP 86-458	8560	228	37.5	2.83	28186	48
LCP 86-463	7681	254	30.2	2.69	22742	39
LCP 86-468	9319	256	36.3	2.32	31253	32
MSD(.05)	2466	20	9.4	0.41	9827	25

* Sampled for breeding purposes only.

Table 24. The 1988 infield variety trial results from plant cane of the 1986 L series on Commerce silt loam soil at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	BROKEN STALKS (%)
CP 65-357	8421	259	32.5	2.60	25015	12
CP 70-321	9449	263	35.9	2.43	29593	37
CP 74-383	10798	251	42.9	2.59	33068	21
LCP 86-393	9938	265	37.5	2.38	31530	27
LCP 86-395	9428	271	34.8	2.55	27424	44
LCP 86-402	11480	239	48.1	3.39	28414	53
LCP 86-408	9296	239	38.9	2.48	31386	31
LCP 86-411	9790	286	34.2	2.30	29916	31
LCP 86-412	9042	269	33.5	3.10	21700	45
LCP 86-414	6344	241	26.4	3.10	17065	20
LCP 86-419	12004	272	44.3	2.55	34701	33
LCP 86-420	11229	257	43.7	2.10	41745	43
LCP 86-422*	7738	277	27.9	3.22	17329	40
LCP 86-426	8826	259	34.0	1.84	37170	20
LCP 86-429	10269	219	47.0	2.45	38584	25
LCP 86-434	9023	247	36.7	2.60	28310	20
LCP 86-435	9731	253	38.6	2.90	26747	10
LCP 86-438	7881	231	34.3	3.12	22038	42
LCP 86-447	11219	249	45.2	2.73	33139	51
LCP 86-450	9568	234	40.9	3.10	26399	43
LCP 86-451	7214	253	28.5	3.14	18357	41
LCP 86-453	9856	274	36.0	3.04	23828	29
LCP 86-454	11226	269	41.8	3.34	25039	31
LCP 86-456*	7551	290	26.1	2.22	23466	33
LCP 86-457	9372	234	40.0	2.22	36062	41
LCP 86-458	8469	236	35.4	2.54	31019	40
LCP 86-463	8160	256	31.8	2.66	24454	52
LCP 86-468	11005	256	43.0	2.34	36693	38
MSD(.05)	3919	22	11.4	0.48	11662	32

Planting date: 9/18/87 Harvest date: 11/28/88

* Sampled for breeding purposes only.

Table 25. The 1988 infield variety trial results from plant cane of the 1986 L series on Sharkey clay soil at St. Gabriel.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	STALK NUMBER (NO./A)	BROKEN STALKS (%)
CP 65-357	6078	263	23.0	2.61	17556	19
CP 70-321	7759	267	29.1	2.48	23496	18
CP 74-383	6967	225	31.0	2.50	24775	33
LCP 86-393	8304	226	36.9	2.29	32414	20
LCP 86-395	6672	257	25.9	2.39	21611	56
LCP 86-402	8223	235	35.0	2.99	23493	53
LCP 86-408	7332	242	30.3	2.51	24310	46
LCP 86-411	6224	253	24.6	2.18	22588	24
LCP 86-412	7087	239	29.7	2.78	21392	34
LCP 86-414	5590	217	25.8	2.75	18758	22
LCP 86-419	8008	259	31.0	2.55	24527	36
LCP 86-420	7182	259	28.0	1.99	27935	43
LCP 86-422*	5111	255	20.1	2.65	15147	35
LCP 86-426	7697	235	32.7	1.97	33192	19
LCP 86-429	7883	200	39.5	2.75	28787	19
LCP 86-434	6850	254	27.0	2.25	24093	32
LCP 86-435	7117	249	28.6	2.87	19896	23
LCP 86-438	6537	233	28.1	2.96	18986	10
LCP 86-447	8414	244	34.5	2.50	27707	25
LCP 86-450	7746	224	34.7	2.90	23894	28
LCP 86-451	7868	262	30.1	2.20	27310	24
LCP 86-453	7740	255	30.3	2.93	20718	25
LCP 86-454	10705	237	45.2	2.96	30513	35
LCP 86-456*	8836	279	31.7	1.71	37145	10
LCP 86-457	9133	239	38.2	2.07	37041	51
LCP 86-458	8652	219	39.6	3.12	25353	55
LCP 86-463	7203	251	28.7	2.73	21030	26
LCP 86-468	7633	256	29.7	2.30	25813	26
MSD(.05)	1571	22	6.2	0.33	4341	28

Planting date: 9/15/87 Harvest date: 12/1/88

* Sampled for breeding purposes only.

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1988 L.S.U. OUTFIELD VARIETY TRIALS[1/]

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The twelve year selection cycle of the Louisiana Sugarcane Variety Improvement Program culminates in the outfield variety trials. The purpose of these trials is to test the most promising experimental varieties across the range of environmental conditions, farm management scenarios and mechanical harvesting situations a successful variety must endure. To accomplish this goal, LSU conducts trials at a number of commercial farms throughout the sugarcane belt.

Six LSU outfield locations were harvested in 1988. Three trials (plant cane, first and second ratoon) were harvested at most of these locations. In these trials, experimental varieties were evaluated along with recommended varieties under commercial farm conditions. The locations of these tests represent the soil types, managerial structures, and weather patterns of the major sugarcane producing areas of the state.

Pathologists and entomologists, from both LSU and USDA, frequently evaluated disease and insect pressures at the outfield locations. These data were recorded and used by the scientists in their respective disciplines to appraise the resistance and/or susceptibility of experimental varieties to specific crop pests.

Six outfield trials were planted in 1988. The locations and dates of planting of the LSU outfield trials planted in 1988 are found in Table 1. The results of routine soil tests of fields in which the 1988 outfield variety trials were planted are found in Table 2. Five commercial and thirteen experimental varieties were planted in outfield trials in 1988 (Table 3).

1/ The data for this report were obtained through a cooperative effort of personnel from the Louisiana Agricultural Experimental Station-LSUAC; USDA-Agricultural Research Service, Sugarcane Research Unit; and the American Sugar Cane League in accordance to the provisions of the "Three-way Agreement of 1978". The testing program would not be possible without full cooperation from the growers at each outfield location.

Of the experimental varieties, one was from the LCP 82 assignment series, three were from the LCP 83 assignment series, one was from the LCP 84 assignment series, and one was from the L 84 assignment series. Three replications of each variety were planted in 3 row plots 32 feet long. Rows were on six foot centers. A randomized complete block design was used at each location. Ten experimental varieties were also introduced to the outfield in 1988.

In 1988, a total of fifteen L.S.U. outfield trials were harvested. The number of millable stalks in all plots in plant cane and first stubble tests were counted in September preceeding harvest.

At harvest time, representatives from L.S.U., USDA, and ASCL were present to characterize tests and varieties. All trials are harvested mechanically. Plots are separated by hand and then weighed with a tractor-mounted hydraulic weigh rig. A fifteen stalk sample was taken from each plot and sent to the USDA sucrose lab at Ardoyne Farm for juice analysis.

Results from the 1988 harvest can be found in Tables 4 through 18. For tests in which stalk counts were made, an analysis was performed for yields based on stalk counts (CNTS) and yields based on plot weights (PWT). Varieties with the notation "KT" following represents Kleentek seed source of this commercial variety introduced to the test location.

Table 1. Locations and dates of planting for the LSU outfield variety trials planted in 1988.

Locations	Planting Date	Soil Type	Soil Texture 1/
A.V. Allain	10/14/88	Baldwin silty clay	s. clay
Evan Hall	10/12/88	Sharkey clay	s. clay
Frank Pearce	10/19/88	Commerce silt loam	s. clay
Lanaux's	09/09/88	Commerce silt loam	s. loam
Glenwood	09/20/88	Commerce silt loam	s. loam
Cinclare	09/22/88	Convent silt loam	v.f.s. loam

1/ s. = silty ; v.f.s. = very fine silty

Table 2. Routine soil test results of 1988 LSU outfield variety test fields.

Locations	P	Na	K	Ca	Mg	S	pH	OM(%)
	mg/kg							
A.V. Allain	136	35	386	4954	1029	7.90	6.1	2.42
Evan Hall	261	40	492	5792	1171	7.78	6.4	1.72
Frank Pearce	152	30	216	2639	559	11.02	5.3	1.70
Lanaux's	293	23	230	2363	523	8.81	5.4	1.41
Glenwood	190	32	144	1631	328	9.69	5.6	1.16
Cinclare	155	19	131	1465	357	5.64	6.7	1.18

Table 3. Varieties planted in the outfield variety trials in 1988.

Commercial varieties	Experimental varieties		Varieties introduced to outfield	
CP65-357	LCP82-089	CP83-644	LCP85-298	CP85-800
CP70-321	CP82-550	LCP84-222	LCP85-336	CP85-803
CP74-383	CP82-551	L84-290	LCP85-352	CP85-830
CP76-331	LCP83-137	CP84-730	LCP85-376	CP85-845
CP79-318	LCP83-149	CP84-738	LCP85-384	CP85-859
	LCP83-153	CP84-746		
	CP83-625			

A. V. ALLAIN & SONS

First stubble and second stubble tests were cut with a two-row and a single row harvester simultaneously in two directions. Plant cane was cut with a two-row harvester only. All varieties were erect and harvested well, except for CP 76-331, CP 79-318, CP 82-551, and LCP 83-153 which had some broken stalks.

Table 4. The 1988 results from the plant cane variety trial at Allain.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	POPULATION PWT (Number/A)	POPULATION CNTS (Number/A)	ERECT-NESS	SCRAP
CP 65-357	3326	257	13.0	3.08	9871	8504	Erect	None
CP 70-321	6922	263	26.3	2.64	23200	21511	Erect	None
CP 74-383	6730	267	25.2	2.95	19864	20369	Erect	None
CP 76-331	7130	273	26.1	2.92	20768	21086	Erect	Some
CP 79-318	7717	257	30.0	2.96	23627	26306	Erect	Some
LCP 82-089	7875	245	32.3	2.93	25847	25836	Erect	None
CP 82-513	7298	241	30.3	2.86	24657	25298	-----	----
CP 82-550	7620	278	27.4	2.32	27527	26553	Erect	None
CP 82-551	5390	247	21.8	2.62	19367	17410	Erect	Some
LCP 83-137	7712	249	30.8	2.17	33261	31617	Erect	None
LCP 83-149	7401	285	25.9	2.40	25219	25029	Erect	None
LCP 83-153	7045	257	27.4	2.59	24636	24536	Erect	Some
CP 83-625	6942	273	25.4	2.70	21931	21847	Erect	None
CP 83-644	9694	288	33.7	2.58	30447	29152	Erect	None
MSD	1136	23	3.1	0.27	3622	2307		

Date Planted: 09/08/87 Soil Type: Baldwin silty clay
Date Harvested: 11/18/88 Harvest Condition: Good

Table 5. The 1988 results from the first stubble variety trial at Allain.

VARIETY	SUGAR YIELD	TRS	CANE YIELD	STALK WEIGHT	POPULATION PWT	POPULATION CNTS	ERECT-NESS	SCRAP
	(LBS/A)	(LBS/T)	(T/A)	(LBS)	(Number/A)			
CP 65-357	3496	186	18.7	2.20	20084	16021	Erect	None
CP 65-357KT	4702	184	25.6	2.14	27882	26307	Erect	None
CP 70-321	3887	198	19.6	1.87	24390	22822	Erect	None
CP 74-383	4606	195	23.6	2.09	26341	26755	Erect	None
CP 76-331	4949	204	24.3	2.15	26314	25522	Erect	None
CP 79-318	4879	204	23.9	2.08	26812	24917	Erect	None
CP 82-089	5382	192	28.1	1.97	33327	34317	Erect	None
CP 82-513	4306	193	22.3	2.23	23276	26553	-----	----
CP 82-550	4816	208	23.1	1.80	29943	27561	Erect	None
CP 82-551	4117	198	20.9	2.04	23830	22071	Erect	None
MSD	1236	NS	5.0	0.47	6066	3204		

Date Planted: 09/12/86 Soil Type: Baldwin silty clay
Date Harvested: 10/26/88 Harvest Condition: Good

Table 6. The 1988 results from the second stubble variety trial at Allain.

VARIETY	SUGAR YIELD	TRS	CANE YIELD	STALK WEIGHT	POPULATION PWT	ERECT-NESS	SCRAP
	(LBS/A)	(LBS/T)	(T/A)	(LBS)	(Number/A)		
CP 65-357	928	205	4.6	1.68	6345	Erect	None
CP 65-357KT	2939	199	14.7	1.73	19936	Erect	None
CP 70-321	1892	188	10.0	1.68	13787	Erect	None
CP 72-356	1995	194	10.2	1.55	16142	Erect	None
CP 72-370	1768	204	8.6	1.56	13189	Erect	None
CP 74-383	4130	195	21.2	1.88	26654	Erect	None
CP 76-331	2002	215	9.3	1.67	12961	Erect	None
CP 79-318	3016	205	14.8	1.88	18442	Erect	None
CP 65-357KT	2939	199	14.7	1.73	19936	Erect	None
MSD	556	NS	2.6	NS	4551		

Date Planted: 11/13/85 Soil Type: Baldwin silty clay
Date Harvested: 10/26/88 Harvest Condition: Good

CINCLARE

The plant cane test was not harvested at this location due to poor germination. The first and second stubble tests were harvested with a one-row harvester in two directions. There was johnsongrass pressure in the test fields. First stubble was erect and harvested well although CP 76-331 and CP 82-551 were broken and slightly scrappy in this test. Second stubble was lodged.

Table 7. The 1988 results from the first stubble variety trial at Cinclare.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	POPULATION PWT (Number/A)	ERECT-NESS	SCRAP
CP 65-357	4877	244	20.3	2.61	18822	Erect	None
CP 65-357KT	7684	253	30.3	2.20	32010	Erect	None
CP 70-321	7151	260	27.4	2.55	25346	Erect	None
CP 70-321KT	7484	261	28.7	2.15	31213	Erect	None
CP 74-383	7595	246	30.9	2.37	30311	Erect	None
CP 76-331	8667	274	31.6	2.94	25142	Erect	Some
CP 79-318	7962	266	29.9	2.50	28385	Erect	None
CP 82-089	7646	232	33.0	2.58	29932	Erect	None
CP 82-513	7047	245	28.8	2.49	26842	-----	----
CP 82-550	7691	290	26.6	2.01	30816	Erect	None
CP 82-551	7746	245	31.6	2.36	31421	Erect	Some
MSD	1854	23	6.4	0.61	9172		

Date Planted: 10/02/86 Soil Type: Convent silt loam
Date Harvested: 11/15/88 Harvest Condition: Good

Table 8. The 1988 results from the second stubble variety trial at Cinclare.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	POPULATION PWT (Number/A)	ERECT-NESS	SCRAP
CP 65-357	4592	291	15.8	2.21	16730	Erect	None
CP 65-357KT	8573	272	31.5	1.91	38426	Erect	None
CP 70-321	5112	280	17.7	1.94	21549	Erect	None
CP 72-356	5491	291	18.9	2.13	20691	Erect	Some
CP 72-370	5540	275	20.2	2.03	23163	Erect	None
CP 74-383	7354	252	29.1	2.11	32221	Erect	None
CP 76-331	5250	295	17.7	2.26	18276	Erect	Some
CP 79-318	7991	289	27.7	2.23	28838	Erect	Some
MSD	1743	20	5.3	0.34	6555		

Date Planted: 09/25/85 Soil Type: Convent silt loam
Date Harvested: 11/15/88 Harvest Condition: Good

EVAN HALL

There was only a plant cane test at this location. Most varieties were leaning at this location. This test was harvested with a two-row harvester cutting in one direction. Some varieties (CP 82-550, LCP 83-149, CP 83-625, and CP 83-644) harvested poorly and there was much scrap. Fields were free of weeds.

Table 9. The 1988 results from the plant cane variety trial at Evan Hall.

VARIETY	SUGAR YIELD	TRS	CANE YIELD	STALK WEIGHT	POPULATION PWT	POPULATION CNTS	ERECT-NESS	SCRAP
	(LBS/A)	(LBS/T)	(T/A)	(LBS)	(Number/A)			
CP 65-357	5069	196	25.9	2.40	25288	23685	Erect	None
CP 70-321	6395	252	25.3	2.45	24055	24783	Erect	None
CP 74-383	5256	229	23.0	2.70	19971	23416	Erect	None
LCP 82-089	5695	207	27.5	2.48	25809	27315	Leaned	None
CP 82-513	5778	209	27.7	2.89	22227	24178	-----	----
CP 82-550	5312	252	21.1	2.19	22489	24133	Erect	Some
CP 82-551	5098	232	21.9	2.19	23303	21466	Erect	Some
LCP 83-137	5096	206	24.8	1.91	30181	28861	Erect	None
LCP 83-149	5091	238	21.4	2.29	21713	25881	Erect	Some
LCP 83-153	5157	214	23.8	2.18	25388	27673	Erect	None
CP 83-625	5326	247	21.6	2.47	20289	22026	Lodged	Much
CP 83-644	6851	254	26.9	2.60	24018	28368	Lodged	Much
MSD	1253	17	3.4	0.21	3578	2948		

Date Planted: 09/11/87 Soil Type: Sharkey clay
Date Harvested: 11/08/88 Harvest Condition: Fair

GLENWOOD

All three tests were cut with a one-row harvester in two directions. Varieties were erect and harvested well in all tests, except for CP 82-551 and CP 83-644 which harvested poorly. Scattered clumps of johnsongrass were present in the first and second stubble tests. There was a heavy johnsongrass population in the plant cane test.

Table 10. The 1988 results from the plant cane variety trial at Glenwood.

VARIETY	SUGAR YIELD	TRS	CANE YIELD	STALK WEIGHT	POPULATION PWT	POPULATION CNTS	ERECT-NESS	SCRAP
	(LBS/A)	(LBS/T)	(T/A)	(LBS)	(Number/A)			
CP 65-357	5854	291	20.1	2.51	18812	18195	Erect	None
CP 70-321	5721	291	19.7	2.26	20278	19001	Erect	None
CP 74-383	6593	258	25.6	2.41	24932	22340	Erect	None
CP 76-331	6827	287	23.9	2.72	20365	22138	Erect	None
CP 79-318	6954	282	24.7	2.35	24720	23730	Erect	None
LCP 82-089	5355	279	19.2	2.53	17648	17366	Erect	None
CP 82-513	5987	261	23.0	2.23	24072	21937	-----	----
CP 82-550	5761	287	20.2	2.03	23195	22990	Erect	None
CP 82-551	5508	262	21.0	2.43	20563	19629	Erect	Some
LCP 83-137	5804	245	23.7	2.32	23838	23685	Erect	None
LCP 83-149	7635	295	25.9	2.26	26653	25701	Erect	None
LCP 83-153	6060	277	21.9	2.34	21786	21803	Erect	None
CP 83-625	6583	308	21.4	2.19	22881	22385	Erect	None
CP 83-644	7215	314	23.0	2.48	21571	24469	Lodged	Much
MSD	1268	17	5.1	0.34	6800	4932		

Date Planted: 09/28/87 Soil Type: Commerce silt loam
Date Harvested: 12/01/88 Harvest Condition: Good

Table 11. The 1988 results from the first stubble variety trial at Glenwood.

VARIETY	SUGAR YIELD	TRS	CANE YIELD	STALK WEIGHT	POPULATION PWT	POPULATION CNTS	ERECT-NESS	SCRAP
	(LBS/A)	(LBS/T)	(T/A)	(LBS)	(Number/A)			
CP 65-357	5258	254	20.7	2.32	20721	19920	Erect	None
CP 70-321	5764	250	23.1	2.03	26707	25231	Erect	None
CP 74-383	7170	244	29.4	2.33	29476	29824	Erect	None
CP 76-331	7027	261	27.0	2.05	30695	29286	Erect	Some
CP 79-318	6846	265	25.8	2.00	30176	29242	Erect	None
CP 82-089	6567	261	25.2	1.77	33050	29376	Erect	None
CP 82-513	6435	254	25.5	2.15	28166	29219	-----	----
CP 82-550	6355	278	22.9	1.66	32093	32301	Erect	None
CP 82-551	6833	260	26.3	2.09	29293	25701	Erect	None
MSD	1246	19	4.1	0.27	7328	6491		

Date Planted: 10/06/86 Soil Type: Commerce silt loam
Date Harvested: 11/10/88 Harvest Condition: Good

Table 12. The 1988 results from the second stubble variety trial at Glenwood.

VARIETY	SUGAR YIELD	TRS	CANE YIELD	STALK WEIGHT	POPULATION PWT	ERECT-NESS	SCRAP
	(LBS/A)	(LBS/T)	(T/A)	(LBS)	(Number/A)		
CP 65-357	3969	246	16.2	2.23	16913	Erect	None
CP 65-357KT	5424	240	22.7	1.76	30000	Erect	None
CP 70-321	5623	254	22.2	1.98	26148	Opened	None
CP 72-356	4227	265	15.9	1.95	19081	Erect	None
CP 72-370	5917	276	21.4	1.81	27845	Erect	None
CP 74-383	6718	233	28.8	2.11	31836	Erect	None
CP 76-331	6442	262	24.6	2.02	28440	Opened	None
CP 79-318	5639	261	21.6	2.04	24872	Erect	None
MSD	605	21	2.6	0.23	5375		

Date Planted: 10/09/85 Soil Type: Commerce silt loam
Date Harvested: 11/10/88 Harvest Condition: Good

LANAUX

Tests at this location were cut with a two-row harvester in one direction. The varieties in the plant cane test were erect. There was some lodging in the first and second stubbles tests. All varieties harvested well except for CP 76-331, which broke up in the second stubble test. Some johnsongrass was present in the alleys only.

Table 13. The 1988 results from the plant cane variety trial at Lanaux.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	POPULATION PWT (Number/A)	ERECTNESS	SCRAP
CP 65-357	8897	297	29.9	2.48	28154	Erect	None
CP 70-321	8406	280	30.1	2.36	29641	Erect	None
CP 74-383	8628	282	30.6	2.47	28834	Erect	None
CP 76-331	9505	301	31.6	2.63	28079	Erect	Some
CP 79-318	8785	293	29.9	2.47	28331	Erect	None
LCP 82-089	8426	292	28.8	2.21	30424	Erect	None
CP 82-513	6747	263	25.7	2.43	24697	-----	----
CP 82-550	7240	291	24.8	2.21	26128	Erect	None
CP 82-551	8031	285	28.2	2.72	24015	Erect	Some
LCP 83-137	7089	264	26.8	1.90	33112	Erect	None
LCP 83-149	7771	305	25.5	2.11	28093	Erect	Some
LCP 83-153	8764	286	30.7	2.31	31098	Erect	None
CP 83-625	8977	295	30.4	2.11	33512	Erect	None
CP 83-644	9329	314	29.7	2.62	26438	Erect	None
MSD	826	13	2.8	0.26	4883		

Date Planted: 09/15/87 Soil Type: Commerce silt loam
Date Harvested: 11/30/88 Harvest Condition: Good

Table 14. The 1988 results from the first stubble variety trial at Lanaux.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	POPULATION PWT (Number/A)	ERECT-NESS	SCRAP
CP 65-357	5857	275	21.3	2.04	24294	Erect	None
CP 65-357KT	6947	284	24.5	1.91	30117	Erect	None
CP 70-321	6355	270	23.5	1.98	27728	Erect	None
CP 70-321KT	4955	248	20.0	1.44	32997	Erect	None
CP 74-383	6860	250	27.5	1.83	34945	Erect	None
CP 76-331	6938	284	24.5	1.89	30269	Erect	None
CP 79-318	6654	272	25.2	1.92	30542	Erect	Some
CP 82-089	6604	264	25.0	1.96	30692	Erect	None
CP 82-513	6356	254	25.1	2.02	28841	-----	----
CP 82-550	6314	284	22.2	1.61	32555	Erect	None
CP 82-551	6760	265	25.5	1.97	30010	Erect	None
MSD	904	18	2.8	0.34	9227		

Date Planted: 09/10/86 Soil Type: Commerce silt loam
Date Harvested: 11/09/88 Harvest Condition: Good

Table 15. The 1988 results from the second stubble variety trial at Lanaux.

VARIETY	SUGAR YIELD (LBS/A)	TRS (LBS/T)	CANE YIELD (T/A)	STALK WEIGHT (LBS)	POPULATION PWT (Number/A)	ERECT-NESS	SCRAP
CP 65-357	5901	285	20.7	1.86	26064	Erect	None
CP 65-357KT	6614	274	24.1	1.78	31779	Erect	None
CP 70-321	5539	273	20.1	1.68	27992	Erect	None
CP 72-356	5429	282	19.1	1.65	27173	Erect	None
CP 72-370	5366	284	18.9	1.52	28962	Erect	None
CP 70-321	5539	273	20.1	1.68	27992	Erect	None
CP 74-383	8272	278	29.8	1.85	37784	Erect	None
CP 76-331	6662	290	23.0	1.80	29762	Erect	Some
CP 79-318	6793	302	23.6	1.90	29117	Erect	None
MSD	1519	NS	3.7	0.34	7474		

Date Planted: 10/02/85 Soil Type: Commerce silt loam
Date Harvested: 11/09/88 Harvest Condition: Good

FRANK PEARCE AND SONS

All three tests at this location was cut with a one-row harvester in two directions. There were patches of raoulgrass and johnsongrass scattered throughout all test fields. First and second stubble tests were erect and harvested well except for CP 79-318, which was lodged and left much scrap. The plant cane test was very lodged and harvested poorly. Five varieties (CP 76-331, CP 79-318, CP 82-550, CP 83-644, and LCP 86-149) harvested poorly and left much scrap in this test.

Table 16. The 1988 results from the plant cane variety trial at Pearce.

VARIETY	SUGAR YIELD	TRS	CANE YIELD	STALK WEIGHT	POPULATION PWT	POPULATION CNTS	ERECT-NESS	SCRAP
	(LBS/A)	(LBS/T)	(T/A)	(LBS)	(Number/A)			
CP 65-357	9271	288	32.2	2.14	35068	31281	Erect	None
CP 70-321	7391	276	26.6	1.30	34315	32155	Lodged	None
CP 74-383	9478	275	34.5	2.06	38992	35090	Erect	None
CP 76-331	6445	281	23.1	1.96	27363	27516	Erect	Much
CP 79-318	7984	292	27.3	1.97	32111	31931	Erect	Much
LCP 82-089	7047	297	23.7	2.01	27865	29354	Erect	None
CP 82-513	7002	233	30.0	2.05	34051	30990	-----	----
CP 82-550	6815	298	22.9	1.70	31271	32446	Opened	Much
CP 82-551	6679	269	24.9	2.14	27078	27875	Erect	None
LCP 83-137	6828	267	25.6	1.64	36264	38698	Erect	Some
LCP 83-149	6991	301	23.3	1.23	29477	35113	Erect	Much
LCP 83-153	6955	260	26.7	2.12	29446	33365	Erect	None
CP 83-625	7936	295	26.9	1.61	38613	33880	Lodged	Some
CP 83-644	7905	290	27.3	2.17	29450	35023	Lodged	Much
MSD	2115	24	5.9	1.09	9014	3139		

Date Planted: 09/12/87 Soil Type: Commerce silt loam
Date Harvested: 11/29/88 Harvest Condition: Fair

Table 17. The 1988 results from the first stubble variety trial at Pearce.

VARIETY	SUGAR YIELD	TRS	CANE YIELD	STALK WEIGHT	POPULATION PWT	POPULATION CNTS	ERECT-NESS	SCRAP
	(LBS/A)	(LBS/T)	(T/A)	(LBS)	(Number/A)			
CP 65-357	7252	300	24.2	2.02	27924	26687	Erect	None
CP 70-321	7572	288	26.3	1.11	36871	29869	Erect	None
CP 74-383	8190	260	31.5	1.98	37530	33589	Erect	None
CP 76-331	6915	291	23.8	1.80	31115	30564	Erect	None
CP 79-318	7477	292	25.6	1.89	31828	33723	Erect	Much
CP 82-089	9098	276	33.0	1.95	39843	41230	Erect	None
CP 82-513	8239	264	31.2	2.01	37402	33701	-----	----
CP 82-550	7341	290	25.3	1.58	37720	33365	Erect	Much
CP 82-551	8309	285	29.2	1.34	34748	31079	Erect	Some
MSD	708	15	3.1	NS	12040	2797		

Date Planted: 09/11/86 Soil Type: Commerce silt loam
Date Harvested: 11/29/88 Harvest Condition: Good

Table 18. The 1988 results from the second stubble variety trial at Pearce.

VARIETY	SUGAR YIELD	TRS	CANE YIELD	STALK WEIGHT	POPULATION PWT	ERECT-NESS	SCRAP
	(LBS/A)	(LBS/T)	(T/A)	(LBS)	(Number/A)		
CP 65-357	4040	202	20.0	1.79	25964	Erect	None
CP 70-321	4240	232	18.5	1.69	25221	Erect	None
CP 72-356	3370	245	13.8	1.67	19290	Erect	None
CP 72-370	4132	239	17.4	1.86	21609	Erect	None
CP 74-383	5597	196	28.5	1.79	37059	Leaned	None
CP 76-331	4437	219	20.3	1.81	26140	Leaned	None
CP 79-318	4982	217	22.8	2.17	24402	Lodged	Much
MSD	1725	41	6.4	0.21	7272		

Date Planted: 11/21/85 Soil Type: Commerce silt loam
Date Harvested: 10/25/88 Harvest Condition: Fair

SUMMARY OF VARIETAL YIELD AND HARVESTABILITY ACROSS THE 1988 OUTFIELD VARIETY TRIAL LOCATIONS

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The purpose of the outfield trials is to test and identify experimental varieties for potential commercial production. These trials are cooperatively conducted at 14 locations throughout the Louisiana sugarcane belt by the Louisiana Agricultural Experiment Station, the United States Department of Agricultural - Agricultural Research Service and the American Sugar Cane League.

The criteria for a successful variety includes reasonable performance with regards to yield and harvestability across locations, crops, and years. The purpose of the outfield variety trials is to evaluate and develop a basis for prediction of yield potential and harvestability of experimental varieties relative to commercial varieties. Accurate varietal evaluation requires overall performance information in addition to close scrutiny of performance under adverse harvest conditions. The objective of this report is to provide an overall and specific location - crop yield and harvest data compilation for 1988 outfield locations.

Location effects on varietal yield: The effect of locations (grouped by soil texture) on varietal yield can be found in tables 1 through 9. Tables 1 through 3 contain plant cane data. Tables 4 through 6 contain first stubble data. Tables 7 through 9 contain second stubble data. The average across locations is also given for each of the respective yield components.

Suitability to Mechanical Harvesting: The harvestability of a sugarcane variety in Louisiana is affected by the erectness and the brittleness of the variety in interaction with the conditions under which it was grown and is harvested (weather, row profile, type and condition of the harvester, and skill of the harvester operator). The harvestability of experimental varieties can be observed under a wide range of

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1/ The data for this report were obtained through a cooperative effort of personnel from the Louisiana Agricultural Experimental Station-LSUAC; USDA- Agricultural Research Service, Sugarcane Research Unit; and the American Sugar Cane League in accordance to the provisions of the "Three-way Agreement of 1978". The testing program would not be possible without full cooperation from the growers at each outfield location.

conditions in the outfield stage of the variety testing program. The suitability of an experimental variety to mechanical harvesting can best be assessed if the condition during harvesting and the harvestabilities of standard varieties in the test field are documented along with the harvestability of the experimental variety.

In 1986 we initiated the process of documenting the particulars of each outfield location. In 1988 we continued the process of evaluating the harvestability of varieties in outfield test. As part of the overall process, the condition of the test field is documented at the time of harvest. As the test field is cut, the outfield agronomists note the erectness (or lack of) of each variety for which yield data will be taken. After the test field is cut, the heap row for each variety is subjectively rated for scrappiness. If a variety is considered to be scrappy or lodged for one replication, it is rated as scrappy or lodged for the entire test, although most varieties behave consistly at a specific location.

The data in tables 10, 11, and 12 represents the number of locations in which each variety was rated in each category with regards to pre-harvest erectness and post-harvest scrap. It should be noted that 1988 was considered a good harvesting year. It can be seen that even in a good harvesting year some varieties do not harvest well under certain conditions. An accumulation of this data will allow for better characterization of varietal suitability to mechanical harvesting under Louisiana conditions.

Table 1. Plant cane sugar yield (pounds per acre) for five commercial and nine experimental varieties at the thirteen outfield locations in 1988.[1/]

	Light textured soil locations								Heavy textured soil locations					
Variety	B.S.	F.P.	Geo.	Gle.	Lan.	O.L.	R.H.	St.J	All.	E.H.	Mag.	McL.	O.H.	Avg.
CP 65-357	5505	9271	6613	5854	8897	8439	6699	7111	3326	5069	7653	8764	7508	7074
CP 70-321	7188	7391	6921	5721	8406	7843	6905	7606	6922	6395	7542	10124	7614	7429
CP 74-383	6451	9478	6209	6593	8628	7779	7463	6426	6730	5256	6612	8350	7044	7166
CP 76-331	7647	6445	7519	6827	9505	9414	8216	6660	7130	----	7878	9553	8473	7939
CP 79-318	6940	7984	7661	6954	8785	8589	7908	7453	7717	----	7795	8916	6973	7784
LCP 82-089	7340	7047	5888	5355	8426	8492	7413	8167	7875	5695	7547	10432	8255	7533
CP 82-513	6227	7002	7162	5987	6747	8195	6307	8055	7298	5778	7586	9546	7203	7161
CP 82-550	6023	6815	6581	5761	7240	7675	6493	6760	7620	5312	7188	8378	7105	6842
CP 82-551	6433	6679	6156	5508	8031	6876	6992	6267	5390	5098	6298	7588	6456	6402
LCP 83-137	5828	6828	5855	5804	7089	6931	5921	7145	7712	5096	6984	8124	6169	6576
LCP 83-149	7808	6991	6658	7635	7771	5069	8385	7124	7401	5091	7550	8561	6828	7111
LCP 83-153	6599	6955	6534	6060	8764	8286	6639	6887	7045	5157	7019	8589	7788	7102
CP 83-625	7347	7936	7343	6583	8977	8525	6625	9686	6942	5326	8049	8728	6668	7595
CP 83-644	7724	7905	7510	7215	9329	8935	7033	6456	9694	6851	9183	9204	7581	8048
MSD	1546	2115	1829	1268	826	976	921	1421	1136	1253	770	877	952	566
Harvest'88	11/21	11/29	12/01	12/01	11/30	12/06	12/08	12/07	11/18	11/08	11/28	12/05	11/17	
Planted'87	09/10	09/12	09/25	09/28	09/15	09/23	10/01	09/18	09/08	09/11	09/30	09/09	09/23	

1/ Locations are: B.S. = Bon Secour, F.P. = F. Pearce, Geo. = Georgia, Gle. = Glenwood, Lan. = Lanaux, O.L. = Oaklawn-light soil, R.H. = R. Hebert, St.J = St. John, All. = Allain, E.H. = Evan Hall, Mag. = Magnolia, McL. = McLeod, O.H. = Oaklawn-heavy soil, Avg. = average over all locations.

Table 2. Plant cane yield of cane (tons per acre) for five commercial and nine experimental varieties at the thirteen outfield locations in 1988.[1/]

	Light textured soil locations								Heavy textured soil locations					
Variety	B.S.	F.P.	Geo.	Gle.	Lan.	O.L.	R.H.	St.J	All.	E.H.	Mag.	McL.	O.H.	Avg.
CP 65-357	25.5	32.2	24.1	20.1	29.9	30.0	27.9	28.6	13.0	25.9	32.0	27.9	29.9	27.1
CP 70-321	27.6	26.6	23.9	19.7	30.1	28.4	29.2	30.2	26.3	25.3	30.0	33.5	29.1	27.7
CP 74-383	26.4	34.5	24.1	25.6	30.6	29.9	30.5	26.9	25.2	23.0	29.6	28.9	28.7	28.1
CP 76-331	27.6	23.1	25.3	23.9	31.6	31.6	30.0	25.4	26.1	----	30.8	31.0	29.8	28.0
CP 79-318	27.9	27.3	27.1	24.7	29.9	30.9	30.9	29.6	30.0	----	30.8	29.4	26.1	28.7
LCP 82-089	28.8	23.7	22.4	19.2	28.8	30.6	29.7	31.0	32.3	27.5	32.3	34.2	31.9	28.6
CP 82-513	26.5	30.0	27.4	23.0	25.7	31.5	28.6	33.2	30.3	27.7	30.8	33.6	29.5	29.1
CP 82-550	23.0	22.9	21.6	20.2	24.8	25.4	24.2	25.7	27.4	21.1	27.0	26.4	25.4	24.2
CP 82-551	25.9	24.9	22.5	21.0	28.2	27.2	27.6	24.1	21.8	21.9	26.8	25.4	24.9	24.6
LCP 83-137	24.9	25.6	23.5	23.7	26.8	26.8	25.4	31.0	30.8	24.8	29.4	28.7	24.8	26.6
LCP 83-149	28.0	23.3	22.8	25.9	25.5	16.7	30.1	27.3	25.9	21.4	29.0	28.1	24.2	25.1
LCP 83-153	28.2	26.7	24.1	21.9	30.7	30.4	28.3	29.3	27.4	23.8	29.9	30.3	30.5	27.8
CP 83-625	27.6	26.9	24.1	21.4	30.4	27.0	25.5	33.2	25.4	21.6	28.3	28.1	22.8	26.3
CP 83-644	28.0	27.3	23.7	23.0	29.7	29.4	26.1	25.2	33.7	26.9	32.8	29.8	27.8	28.0
MSD	3.1	5.9	6.5	5.1	2.8	3.7	3.7	4.8	3.1	3.4	2.6	2.5	3.5	1.9
Harvest'88	11/21	11/29	12/01	12/01	11/30	12/06	12/08	12/07	11/18	11/08	11/28	12/05	11/17	
Planted'87	09/10	09/12	09/25	09/28	09/15	09/23	10/01	09/18	09/08	09/11	09/30	09/09	09/23	

1/ Locations are: B.S. = Bon Secour, F.P. = F. Pearce, Geo. = Georgia, Gle. = Glenwood, Lan. = Lanaux, O.L. = Oaklawn-light soil, R.H. = R. Hebert, St.J = St. John, All. = Allain, E.H. = Evan Hall, Mag. = Magnolia, McL. = McLeod, O.H. = Oaklawn-heavy soil, Avg. = average over all locations.

Table 3. Plant cane sugar yield (pounds per ton) for five commercial and nine experimental varieties at the thirteen outfield locations in 1988.[1/]

	Light textured soil locations								Heavy textured soil locations					
Variety	B.S.	F.P.	Geo.	Gle.	Lan.	O.L.	R.H.	St.J	All.	E.H.	Mag.	McL.	O.H.	Avg.
CP 65-357	216	288	275	291	297	281	240	248	257	196	239	314	251	261
CP 70-321	260	276	290	291	280	276	237	252	263	252	252	302	261	267
CP 74-383	244	275	258	258	282	260	245	240	267	229	223	289	249	255
CP 76-331	277	281	297	287	301	298	274	263	273	---	255	308	285	283
CP 79-318	248	292	282	282	293	278	255	252	257	---	253	304	267	272
LCP 82-089	255	297	261	279	292	278	250	263	245	207	233	306	259	263
CP 82-513	235	233	261	261	263	260	220	243	241	209	247	284	244	246
CP 82-550	262	298	305	287	291	302	268	263	278	252	266	318	280	282
CP 82-551	249	269	274	262	285	256	254	260	247	232	235	299	259	260
LCP 83-137	234	267	249	245	264	258	233	230	249	206	238	283	249	246
LCP 83-149	278	301	292	295	305	305	278	262	285	238	261	305	282	284
LCP 83-153	235	260	271	277	286	272	234	235	257	214	235	284	256	255
CP 83-625	266	295	305	308	295	315	260	291	273	247	285	311	293	288
CP 83-644	275	290	316	314	314	304	270	256	288	254	279	309	273	288
MSD	57	24	19	17	13	16	19	20	23	17	18	14	24	7
Harvest'88	11/21	11/29	12/01	12/01	11/30	12/06	12/08	12/07	11/18	11/08	11/28	12/05	11/17	
Planted'87	09/10	09/12	09/25	09/28	09/15	09/23	10/01	09/18	09/08	09/11	09/30	09/09	09/23	

1/ Locations are: B.S. = Bon Secour, F.P. = F. Pearce, Geo. = Georgia, Gle. = Glenwood, Lan. = Lanaux, O.L. = Oaklawn-light soil, R.H. = R. Hebert, St.J = St. John, All. = Allain, E.H. = Evan Hall, Mag. = Magnolia, McL. = McLeod, O.H. = Oaklawn-heavy soil, Avg. = average over all locations.

Table 4. First stubble sugar yield (pounds per acre) for five commercial and four experimental varieties at the thirteen outfield locations in 1988.[1/]

	Light textured soil locations									Heavy textured soil locations				
Variety	B.S.	Cin.	F.P.	Geo.	Gle.	Lan.	O.L.	R.H.	St.J	All.	Mag.	McL.	O.H.	Avg.
CP 65-357	6530	4877	7252	6237	5258	5857	6429	5640	6082	3496	7599	3829	5265	5719
CP 65-357KT	----	7684	----	6583	----	6947	6165	5027	6316	4702	7417	5500	5639	----
CP 70-321	7481	7151	7572	7121	5764	6355	7966	5277	7534	3887	8260	6721	7919	6847
CP 70-321KT	----	7484	----	5719	----	4955	8023	4519	7187	----	7780	7730	6393	----
CP 74-383	6645	7596	8190	6257	7170	6860	6084	7263	5436	4606	7047	5955	6020	6548
CP 76-331	7530	8667	6915	7158	7027	6938	7725	5634	6853	4949	7637	6972	6448	6893
CP 79-318	7138	7962	7477	6147	6846	6654	8298	6025	6857	4879	8556	5692	5920	6808
LCP 82-089	7420	7646	9098	7178	6567	6604	8488	6861	7527	5382	8530	5631	7598	7271
CP 82-513	7147	7047	8239	6368	6435	6356	8021	6024	6678	4306	8330	6196	7097	6781
CP 82-550	7338	7691	7341	6463	6355	6314	7796	6842	7382	4816	8514	5972	6484	6895
CP 82-551	7256	7746	8309	7540	6833	6760	7172	7149	7124	4117	7850	4107	6770	6826
MSD	n.s.	1854	708	n.s.	1246	904	925	1403	1258	1236	1339	1444	812	445
Harvest'88	11/21	11/15	11/29	11/14	11/10	11/09	11/03	11/02	10/27	10/26	11/07	11/01	10/28	
Planted'86	09/09	10/02	09/11	09/29	10/06	09/10	09/12	09/16	09/04	09/12	10/08	10/30	09/24	

[1/] Locations are: B.S. = Bon Secour, Cin. = Cinclare, F.P. = F. Pearce, Geo. = Georgia, Gle. = Glenwood, Lan. = Lanaux, O.L. = Oaklawn-light soil, R.H. = R. Hebert, St.J = St. John, All. = Allain, Mag. = Magnolia, McL. = McLeod, O.H. = Oaklawn-heavy soil, Avg. = average over all locations.

"KT" represents Kleentek seed source introduced to the outfield locations.

Table 5. First stubble cane yield (tons per acre) for five commercial and four experimental varieties at the thirteen outfield locations in 1988.[1/]

	Light textured soil locations									Heavy textured soil locations				
Variety	B.S.	Cin.	F.P.	Geo.	Gle.	Lan.	O.L.	R.H.	St.J	All.	Mag.	McL.	O.H.	Avg.
CP 65-357	23.2	20.3	24.2	24.0	20.7	21.3	29.5	23.9	28.2	18.7	29.1	15.8	24.8	23.4
CP 65-357KT	----	30.3	----	28.0	----	24.5	28.3	21.7	29.2	25.6	30.1	22.5	25.9	----
CP 70-321	28.7	27.4	26.3	26.3	23.1	23.5	32.9	23.5	34.7	19.6	29.8	24.9	33.3	27.2
CP 70-321KT	----	28.7	----	23.4	----	20.0	32.9	20.4	33.6	----	28.5	29.6	29.3	----
CP 74-383	27.1	30.9	31.5	25.7	29.4	27.5	28.6	31.4	28.2	23.6	28.3	23.0	29.3	28.1
CP 76-331	28.1	31.6	23.8	25.9	27.0	24.5	29.5	22.7	29.8	24.3	27.2	25.5	27.3	26.6
CP 79-318	26.9	29.9	25.6	22.5	25.8	25.2	34.0	26.3	32.6	23.9	32.7	21.5	26.8	27.2
LCP 82-089	27.2	33.0	33.0	29.9	25.2	25.0	37.2	29.3	36.6	28.1	34.3	22.5	35.5	30.5
CP 82-513	27.2	28.8	31.2	26.3	25.5	25.1	35.8	25.8	33.5	22.3	32.8	25.2	32.0	28.6
CP 82-550	25.1	26.6	25.3	22.6	22.9	22.3	29.4	24.8	32.6	23.1	29.4	20.4	25.1	25.5
CP 82-551	27.2	31.6	29.2	29.2	26.3	25.5	31.9	26.8	32.1	20.9	30.8	15.7	29.6	27.4
MSD	3.8	6.4	3.1	n.s.	4.1	2.8	3.4	4.5	5.9	5.0	4.6	6.1	2.7	1.6
Harvest'88	11/21	11/15	11/29	11/14	11/10	11/09	11/03	11/02	10/27	10/26	11/07	11/01	10/28	
Planted'86	09/09	10/02	09/11	09/29	10/06	09/10	09/12	09/16	09/04	09/12	10/08	10/30	09/24	

1/ Locations are: B.S. = Bon Secour, Cin. = Cinclare, F.P. = F. Pearce, Geo. = Georgia, Gle. = Glenwood, Lan. = Lanaux, O.L. = Oaklawn-light soil, R.H. = R. Hebert, St.J = St. John, All. = Allain, Mag. = Magnolia, McL. = McLeod, O.H. = Oaklawn-heavy soil, Avg. = average over all locations.

"KT" represents Kleentek seed source introduced to the outfield locations.

Table 6. First stubble sugar yield (pounds per ton) for five commercial and four experimental varieties at the thirteen outfield locations in 1988.[1/]

Variety	Light textured soil locations									Heavy textured soil locations				Avg.
	B.S.	Cin.	F.P.	Geo.	Gle.	Lan.	O.L.	R.H.	St.J	All.	Mag.	McL.	O.H.	
CP 65-357	282	244	300	260	254	275	218	236	216	186	261	244	212	245
CP 65-357KT	---	253	---	235	---	284	218	232	216	184	246	246	217	---
CP 70-321	261	260	288	271	250	270	242	223	217	198	277	270	238	251
CP 70-321KT	---	261	---	244	---	248	244	222	214	---	273	261	217	---
CP 74-383	245	246	260	241	244	250	213	230	193	195	250	260	206	233
CP 76-331	268	274	291	278	261	284	261	248	230	204	280	274	236	260
CP 79-318	266	266	292	274	265	272	244	229	210	204	261	265	221	251
LCP 82-089	272	232	276	241	261	264	228	234	205	192	248	250	214	240
CP 82-513	263	245	264	242	254	254	224	233	200	193	255	248	222	238
CP 82-550	292	290	290	286	278	284	266	275	231	208	290	294	258	272
CP 82-551	266	245	285	258	260	265	225	266	222	198	255	261	228	249
MSD	21	23	15	22	19	18	22	26	33	n.s.	18	22	17	6
Harvest'88	11/21	11/15	11/29	11/14	11/10	11/09	11/03	11/02	10/27	10/26	11/07	11/01	10/28	
Planted'86	09/09	10/02	09/11	09/29	10/06	09/10	09/12	09/16	09/04	09/12	10/08	10/30	09/24	

1/ Locations are: B.S. = Bon Secour, Cin. = Cinclare, F.P. = F. Pearce, Geo. = Georgia, Gle. = Glenwood, Lan. = Lanaux, O.L. = Oaklawn-light soil, R.H. = R. Hebert, St.J = St. John, All. = Allain, Mag. = Magnolia, McL. = McLeod, O.H. = Oaklawn-heavy soil, Avg. = average over all locations.

"KT" represents Kleentek seed source introduced to the outfield locations.

Table 7. Second stubble sugar yield (pounds per acre) for seven commercial varieties at the ten outfield locations in 1988.[1/]

	Light textured soil locations							Heavy textured soil locations			
Variety	Cin.	F.P.	Geo.	Gle.	Lan.	R.H.	St.J	Mag.	McL.	O.H.	Avg.
CP 65-357	4592	4040	6886	3969	5901	6604	5266	7191	3656	5984	5437
CP 65-357KT	8573	----	7026	5424	6614	5932	5094	----	----	5765	----
CP 70-321	5112	4240	7310	5623	5539	5873	5899	7412	6588	5820	5942
CP 72-356	5491	3370	7620	4227	5429	6890	6030	8205	6118	6717	6193
CP 72-370	5540	4132	7689	5917	5366	6997	4917	7745	5615	6233	6015
CP 74-383	7354	5597	7647	6718	8272	7165	4841	5526	5937	6304	6536
CP 76-331	5250	4437	8739	6442	6662	5772	5719	6430	6098	6357	6191
CP 79-318	7991	4982	8125	5639	6793	7509	5747	7519	5849	5839	6593
MSD	1743	1725	1186	605	1519	1403	859	2129	930	n.s.	495
Harvest'88	11/15	10/25	11/14	11/10	11/09	11/02	10/27	11/07	11/01	10/28	
Planted'85	09/25	11/21	10/04	10/09	10/02	10/14	09/26	10/03	10/15	10/10	

[1/] Locations are: Cin. = Cinclare, F.P. = F. Pearce, Geo. = Georgia, Gle. = Glenwood, Lan. = Lanaux, R.H. = R. Hebert, St.J = St. John, Mag. = Magnolia, McL. = McLeod, O.H. = Oaklawn-heavy soil
Avg. = average over all locations.

"KT" represents Kleentek seed source introduced to the outfield locations.

Table 8. Second stubble cane yield (tons per acre) for seven commercial varieties at the ten outfield locations in 1988.[1/]

	Light textured soil locations							Heavy textured soil locations			
Variety	Cin.	F.P.	Geo.	Gle.	Lan.	R.H.	St.J	Mag.	McL.	O.H.	Avg.
CP 65-357	15.8	19.9	27.0	16.2	20.7	26.2	27.4	29.9	15.1	28.7	22.9
CP 65-357KT	31.5	----	26.7	22.7	24.1	24.6	26.5	----	----	27.2	----
CP 70-321	17.7	18.5	26.9	22.2	20.1	24.9	28.1	27.6	25.5	26.2	23.8
CP 72-356	18.9	13.8	28.1	15.9	19.1	26.2	29.8	32.3	24.5	29.7	24.7
CP 72-370	20.2	17.4	28.2	21.4	18.9	26.4	24.0	29.4	20.5	25.0	23.1
CP 74-383	29.1	28.5	29.3	28.8	29.8	29.3	27.0	24.3	24.9	32.0	28.3
CP 76-331	17.7	20.3	30.6	24.6	23.0	22.1	26.9	24.1	21.9	26.4	23.8
CP 79-318	27.7	22.8	30.5	21.6	23.6	28.3	28.6	30.0	21.5	26.6	26.1
MSD	5.3	6.4	5.2	2.6	3.7	5.3	3.6	7.4	3.7	7.4	2.7
Harvest'88	11/15	10/25	11/14	11/10	11/09	11/02	10/27	11/07	11/01	10/28	
Planted'85	09/25	11/21	10/04	10/09	10/02	10/14	09/26	10/03	10/15	10/10	

[1/] Locations are: Cin. = Cinclare, F.P. = F. Pearce, Geo. = Georgia, Gle. = Glenwood, Lan. = Lanaux, R.H. = R. Hebert, St.J = St. John, Mag. = Magnolia, McL. = McLeod, O.H. = Oaklawn-heavy soil
Avg. = average over all locations.

"KT" represents Kleentek seed source introduced to the outfield locations.

Table 9. Second stubble sugar yield (pounds per ton) for seven commercial varieties at the ten outfield locations in 1988.[1/]

	Light textured soil locations							Heavy textured soil locations			
Variety	Cin.	F.P.	Geo.	Gle.	Lan.	R.H.	St.J	Mag.	McL.	O.H.	Avg.
CP 65-357	291	202	255	246	285	253	192	242	243	209	240
CP 70-321	290	232	272	254	273	234	210	267	258	225	252
CP 72-356	291	245	271	265	282	263	203	255	250	226	254
CP 72-370	275	239	272	276	284	265	205	263	275	250	260
CP 74-383	252	196	261	233	278	245	180	227	239	197	231
CP 76-331	295	219	285	262	290	261	213	268	279	241	261
CP 79-318	289	217	267	261	302	265	201	251	272	220	253
CP 65-357KT	272	---	264	240	274	241	192	---	---	212	---
MSD	20	41	18	21	n.s.	12	30	28	13	20	8
Harvest'88	11/15	10/25	11/14	11/10	11/09	11/02	10/27	11/07	11/01	10/28	
Planted'85	09/25	11/21	10/04	10/09	10/02	10/14	09/26	10/03	10/15	10/10	

[1/] Locations are: Cin. = Cinclare, F.P. = F. Pearce, Geo. = Georgia, Gle. = Glenwood, Lan. = Lanaux, R.H. = R. Hebert, St.J = St. John, Mag. = Magnolia, McL. = McLeod, O.H. = Oaklawn-heavy soil
Avg. = average over all locations.

"KT" represents Kleentek seed source introduced to the outfield locations.

Table 10. Number of outfield plant cane locations in which the variety was rated in the designated category.

	PRE-HARVEST ERECTNESS				POST-HARVEST SCRAP		
VARIETY	ERECT	LEAN	OPEN	LODGE	NONE	LITTLE	MUCH
CP 65-357	13				13		
CP 70-321	11	1		1	13		
CP 74-383	13				13		
CP 76-331	11	2			7	5	1
CP 79-318	11	1	1		11	1	1
CP 82-550	10	2	1		10	2	1
CP 82-551	13				6	6	1
LCP 82-089	10	3			13		
CP 83-625	10	1		2	10	2	1
CP 83-644	9			4	7	2	4
LCP 83-137	12		1		10	3	
LCP 83-149	12	1			9	2	2
LCP 83-153	13				11	2	

Table 11. Number of outfield first ratoon locations in which the variety was rated in the designated category.

	PRE-HARVEST ERECTNESS				POST-HARVEST SCRAP		
VARIETY	ERECT	LEAN	OPEN	LODGE	NONE	LITTLE	MUCH
CP 65-357	14				14		
CP 70-321	13			1	14		
CP 74-383	14				14		
CP 76-331	14				8	4	2
CP 79-318	14				10	2	2
CP 82-550	13			1	11		3
CP 82-551	13	1			10	4	
LCP 82-089	13	1			14		

Table 12. Number of outfield second ratoon locations in which the variety was rated in the designated category.

	PRE-HARVEST ERECTNESS				POST-HARVEST SCRAP		
VARIETY	ERECT	LEAN	OPEN	LODGE	NONE	LITTLE	MUCH
CP 65-357	10	1			11		
CP 70-321	9		1	1	11		
CP 74-383	10	1			11		
CP 76-331	8	1	1	1	8	3	
CP 79-318	9	1		2	8	2	1

Table 10. Number of outfield plant cane locations in which the variety was rated in the designated category.

	PRE-HARVEST ERECTNESS				POST-HARVEST SCRAP		
VARIETY	ERECT	LEAN	OPEN	LODGE	NONE	LITTLE	MUCH
CP 65-357	13				13		
CP 70-321	11	1		1	13		
CP 74-383	13				13		
CP 76-331	11	2			7	5	1
CP 79-318	11	1	1		11	1	1
CP 82-550	10	2	1		10	2	1
CP 82-551	13				6	6	1
LCP 82-089	10	3			13		
CP 83-625	10	1		2	10	2	1
CP 83-644	9			4	7	2	4
LCP 83-137	12		1		10	3	
LCP 83-149	12	1			9	2	2
LCP 83-153	13				11	2	

Table 11. Number of outfield first ratoon locations in which the variety was rated in the designated category.

	PRE-HARVEST ERECTNESS				POST-HARVEST SCRAP		
VARIETY	ERECT	LEAN	OPEN	LODGE	NONE	LITTLE	MUCH
CP 65-357	14				14		
CP 70-321	13			1	14		
CP 74-383	14				14		
CP 76-331	14				8	4	2
CP 79-318	14				10	2	2
CP 82-550	13			1	11		3
CP 82-551	13	1			10	4	
LCP 82-089	13	1			14		

Table 12. Number of outfield second ratoon locations in which the variety was rated in the designated category.

	PRE-HARVEST ERECTNESS				POST-HARVEST SCRAP		
VARIETY	ERECT	LEAN	OPEN	LODGE	NONE	LITTLE	MUCH
CP 65-357	10	1			11		
CP 70-321	9		1	1	11		
CP 74-383	10	1			11		
CP 76-331	8	1	1	1	8	3	
CP 79-318	9	1		2	8	2	1

Sucrose Lab Activities - 1988 Harvest Season

Eugene LeBlanc, Jr. and F. A. Martin
Sugar Station

During the 1988 harvest season, a total of 5051 sugarcane samples were processed at the St. Gabriel Sucrose Laboratory. In order to determine percent fiber, 279 sugarcane samples were run by the press analysis. The remainder were run through the roller mill by the St. Gabriel sucrose laboratory.

Table 1 presents a breakdown of the number of sugarcane samples processed for each specific department.

An IBM Personal Computer was used in our laboratory analysis work in 1988. The system has improved the efficiency of data generation and storage in our laboratory.

Table 1. Number of sugarcane samples processed at the St. Gabriel Sucrose Laboratory during the 1988 harvest season

	Number of samples
Cooperative Extension Service	36
Cultural Practices and Fertility	672
Plant Pathology	345
Variety Development*	
Genetic Studies	2047
Selection	745
Infield	1206
	5051

*Samples From the Outfield Locations Are Processed at the USDA Laboratory at Chacahoula.

Department of Agricultural Economics and Agribusiness
Sugarcane Research Report for 1988

Brian A. Chapman, Ralph D. Christy, and John G. Lee

Department of Agricultural Economics and Agribusiness

Annual Projections of Costs and Returns from the Production of Sugarcane:

The Department of Agricultural Economics and Agribusiness Farm Management Committee issued its 1989 Sugarcane Costs and Returns Projections in January of this year. The budgets were published with in the department's A.E.A. Information Series No. 74. Cost projections showed an increase over 1988 projections due to refinement of projection technique, updated producer survey data, and modest increases in producer input prices. Cost estimates were presented on a per acre basis (Table 1). To enable a projection of total farm costs, the costs associated with each item or activity should be multiplied by the number of acres on which each activity was performed.

Table 1. Summary of Estimated Costs per Acre for Selected Sugarcane Production Activities, Louisiana, 1989.

Item	Direct Costs	Fixed Costs	Total Costs
	- - - - - - dollars - - - - -		
Fallow Program	31.67	20.26	51.93
Seedbed Preparation	39.15	23.81	62.96
Planting Seed Cane	79.33	37.77	117.10
Plant Cane (River)	140.34	28.85	169.20
Plant Cane (Teche)	166.94	28.78	195.72
1st Stubble (River)	140.34	28.85	169.20
1st Stubble (Teche)	166.94	28.78	195.72
2nd Stubble (River)	145.40	28.85	174.25
2nd Stubble (Teche)	172.00	28.78	200.78
1-row Harvest, Direct Haul	81.08	59.16	140.24
1-row Harvest, Transloaded	56.41	40.64	97.05
2-row Harvest, Direct Haul	77.73	61.36	139.09
2-row Harvest, Transloaded	53.07	42.84	95.90
Overhead Cost	39.22	13.44	52.66

The procedure for estimating the cost associated with planting assumed mechanically planted field-run seed cane with one acre of seed planting five acres of prepared land. Harvesting and transportation cost estimates were based on yields of 30 tons of sugarcane per acre and an average one-way haul of seven miles.

Economic Criteria for Rotation Selection:

In a paper presented at the 1988 Inter-American Sugar Cane Seminars, expected net income was used as a criterion to assess expected sugarcane yields for selecting among alternative, sustainable, fallow - plant cane - stubble rotation schemes. The paper introduced a procedure whereby all relative expected yield combinations can be assessed with a minimal number of calculations using a computerized spreadsheet. To illustrate the procedure two popular rotations were examined, 40:40:20 and 33:33:33.

Updating Producer Survey Data:

The department's 1982 producer survey database was update during the Summer of 1988. A total of 80 producers were surveyed with half representing the River and Bayou Lafourche regions and half representing the Bayou Teche region. The survey was designed so as to include 10 farms in each region in each of four approximate size categories, 150 acres, 550 acres, 1320 acres, and 2100 acres. The database is maintained for a variety of economic analyses conducted by the department.

Economies of Size Analyses for Raw Sugar Manufacturing:

Three separate analyses were conducted by the department to estimate size economies in Louisiana's raw sugar manufacturing industry. These estimates were sought as measures of economic efficiencies, given structural adjustments in the industry toward fewer and larger firms. The first of these analyses utilized the statistical cost approach. Primary cross-sectional data from 1979 through 1985 indicated that on average the industry is experiencing increasing returns to size. Implications of the analysis pointed to the industry continuing to adjust toward few large firms. A description of the analysis and its results are included in a paper entitled, "Economies of Size in the Louisiana Sugarcane Processing Industry" by Brian A. Chapman and Ralph Christy, due to be published in the 9th volume of the Journal (of the) American Society of Sugar Cane Technologists.

The second analysis utilized the accounting approach. Data from individual income statements of raw sugar manufacturers in the state from 1979 through 1985 were used to calculate the operating cost per unit of output. These values were grouped into

three categories by mill size, based on daily tons ground. Results indicated that larger firms on average operated at a lower cost per unit of output; thereby suggesting increasing returns to size.

The third analysis utilized a short-run cost model to measure technical efficiency. A translog cost function was estimated using Zellner's seemingly unrelated regression procedure. Results indicated that the Louisiana sugarcane processing industry possesses characteristics of a homogeneous oligopoly. The results from the model indicated: 1) that the average mill has over-invested in plant and equipment; 2) the existence of multiproduct economies of scale; and 3) the average mill by producing beyond the scale-mean level will lower its average cost of production. This analysis was part of a department masters thesis which also sought to describe the structure of the Louisiana industry, as well as describing technical efficiencies and structure of the sugar cane processing industry in the Dominican Republic.

Comparing Performance of Cooperative and Privately-held Raw Sugar Manufacturers:

A comparison of technical and economic performance measures for Louisiana's cooperative and private raw sugar manufacturers was made in an attempt to identify relationships between firm organization performance. The application of industrial organization theory to the study of cooperatives assumes that cooperatives operate under the rationale of a "competitive yardstick". That is a cooperative can only exist under the conditions of a market failure and that its performance is measured in how it can influence the behavior and performance of the privately owned firms operating in the same market. For the framework to be applied to the analysis of cooperative performance, we are implicitly assuming the "cooperative as firm model" which proports cooperatives to have essentially no different economic features (i.e., profit goal and central decision unit) as any other business organization. Primary and secondary operating cost, income and physical data for ten cooperative and eight private processors from 1979 through 1987 were used to calculate the commercial recoverable sugar (CRS), the average total cost per pound of raw sugar produced, and the profit-volume ratio for each firm for each of the nine years. The group mean (i.e., Cooperative vs. Private) for each measure was calculated for each year. To identify significant differences between paired means, the null-hypothesis was evaluated using the t-test.

Results indicated that no significant differences exist between the average CRS of the groups at the 1.0 percent level. The average per unit cost for the two groups was shown to be significantly different. Private processors on average operated at higher total cost per unit of output. Yet some years, cooperatives operated at average cost significantly higher than their private counterparts. It was further demonstrated that the

source of these higher costs were primarily variable components. The profit-volume ratios were significantly different between the two groups. Private manufacturers averaged higher ratios for the nine year period, with higher annual ratios five of the nine years. Considering near uniform product pricing and operational similarities, differences in the profit-volume ratios were inconsistent with conclusions concerning cost differences.
As data on subsequent grinding seasons comes available, the analysis may be repeated and the comparison of performance measures reexamined.

Updating Processor Survey Data:

The department's annual survey of the state's raw sugar manufacturers was continued in 1988. Nineteen of the twenty factories producing raw sugar cooperated in the survey. The database serves as the basis for a number of economic analyses. The results of these analyses are available from the department.

Cost and Returns from Raw Sugar Manufacturing:

A document summarizing the costs and returns from raw sugar manufacturing for crop years 1979 through 1986 was completed during 1988. The publication of this document was delayed so as to include cost and return results from the 1987 crop year within the same document. Data for the report was supplied by individual mills from their audited financial statements and selected technical performance reports. The costs and returns summaries are reported in a number of aggregate table by region (i.e., River and Bayou Lafourche vs. Bayou Teche), type of firm organization (i.e., cooperatives vs. private), and state average. The final report is expected to be available by late spring, 1989.

Processing and Distribution Systems for Louisiana Food and Agricultural Products[1]

John Henry Wells, Assistant Professor
Nitin R. Manelkar, Graduate Assistant
Department of Agricultural Engineering

Sugarcane Collection and Delivery:

Ongoing research within the Louisiana Agricultural Experiment Station includes the evaluation of processing and distribution systems for Louisiana food and agricultural products. One aspect of this effort is the study of collection, transportation, and delivery of agricultural products from the farm-gate to the processing plant. Such research is important to the sugar industry because sugar cane deterioration starts immediately after cutting and continues throughout the collection and delivery phases of handling prior to milling. During these phases, delays in in-field collection, equipment failure, transportation, and mill-yard accumulation influence recoverable sugars, dextran development and other parameters important to sugar factory operations and profitability. Previous investigators have quantified the deterioration of cane based on loss of sucrose and increase in impurities. Furthermore, it has been observed that temperature had an important effect on the rate of decline in purity.

The collection, transportation and delivery of Louisiana sugarcane from the farm-gate to the processing plant was targeted for study in 1988. An exhaustive survey of the literature relating to postharvest deterioration of sugarcane indicated that the loss of sucrose through the formation of dextran could be aggravated by transportation delays and handling mismanagement. A mail survey of 21 sugar factories was conducted to collect information about local harvest logistics. The survey was designed to document the collection and delivery practices for Louisiana sugarcane relative to factory organization, sugarcane transport, and factory yard management. Sixteen of surveys were returned representing factories with an average daily processing capacity from 1800 to 9000 tons/day of sugarcane. The survey indicated that on average over 47% of the sugar cane was delivered through a transloader site and that up to 75% was "double handled" at certain mills. The survey reviled that dextran analyses of sugarcane samples were conducted at 18.75% of Louisiana sugar mills with 12.5% of the factories penalizing growers for delivery of high dextran sugarcane. Additionally, 87% of the factories believed that transportation and yard management contributed to problems with dextran during processing. The survey showed that research into alternative transportation and handling systems for Louisiana sugarcane is needed. A simulation study of current collection and delivery practices was initiated during 1988.

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[1] Louisiana Agricultural Experiment Station Project No. LAB02654

Examination of the collection and delivery system for Louisiana sugarcane is significant in that management lacks the necessary criteria to evaluate the performance of alternative handling system with respect to losses in recoverable sugars and dextran production. To date, research has shown a qualitative relationship between sugarcane handling and postharvest deterioration, however, these relationships have not been analyzed for Louisiana conditions within the structure of an integrated logistical and quality-deterioration model. Project research during 1988 demonstrated that computer simulation can be used to evaluate the effects of alternative transportation systems and sugar cane handling practices. A planned comprehensive computer simulation that includes a mathematical description postharvest deterioration will aid in developing specific recommendations for the implementation of alternative cane yard storage systems. The expanded simulation analysis will include an economic analysis of alternative transportation systems. The goal of this work will be to elucidate specific handling and/or scheduling recommendations for sugar factory operators that improve the postharvest quality and quality consistency of sugar cane deliveries. Implementation of research recommendations could lead to the improved profitability of the sugar industry. Future work may include the development of computer-aided procedures that can be used by growers and factory operators for harvest and delivery scheduling and the selection of appropriately sized transport and handling units.

Sugarcane Related Publications:

Manelkar, N.R. and Wells, J.H. 1988. The enigma of dextrans in sugarcane processing. Report prepared for the Department of Agricultural Engineering, Louisiana State University Agricultural Center, Baton Rouge, LA.

Wells, J.H., Manelkar, N.R. and Day, D.F. Analysis of collection and delivery system for Louisiana sugar cane. ASAE 1989 Summer Meeting.

DEXTRAN SURVEY 1988

Durriya Sarkar
Audubon Sugar Institute

Since 1986 we have been conducting a dextran survey of Louisiana sugar mills. This year we had fifteen mills reporting daily dextran in sugar and three mills sending their dextran data for sugar composites when available. Weekly forms for dextran data were sent to all the mills. The mills returned the forms with daily sugar dextran values, high and low temperatures and rainfall. They also made notes of washout dates, stoppages and other relevant occurrences. Two mills also reported their data for juice analysis done at their mills. One mill did daily composites for cane brought by each farmer by the ASI II method. The morning composites of the crusher and the dilute juices were also analyzed. They sent dextran data for each individual farmer, the crusher and dilute juices and also the calculated weighted average for dextran in juice for all the farmers. The other mill did their daily juice composites of each farmer by the Quick Haze method and reported the average dextran in juice.

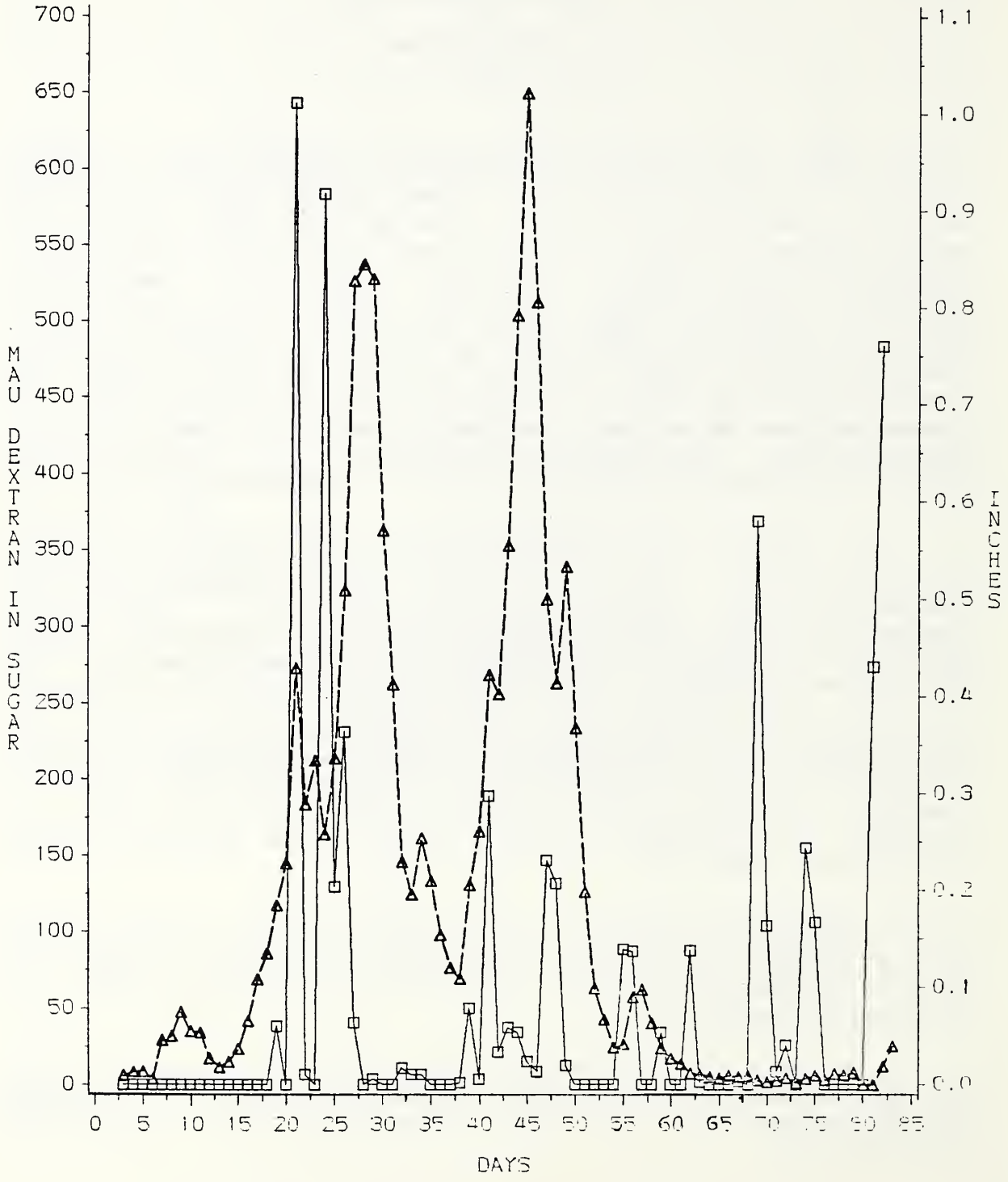
All the data were compiled and the averages calculated. Each mill was sent a report of their dextran values plotted versus the average for the fifteen mills. 1988 was a fair year for the mills with the average dextran being above penalty level for 16 days out of a total grinding period of 85 days. Dextran occurred in sugar after we had rain combined with warmer temperatures. The dextran in the juices correlated very well with the sugar dextran.. The last season (1987) had been an excellent year when the average dextran did not reach penalty level at any time during the season. The mills have been aware of dextran problems in the past and do try and minimize its occurrence in sugar by better control of the cane yard and using biocides or chlorine in keeping their mills clean. By monitoring and blending their sugar most of the mills have avoided paying penalties to the refiners. After it rains, and the temperature remains high, dextran comes into the mill with the cane.

Figure 1 is the plot of the average dextran for all Louisiana mills reporting daily dextran in sugar versus the average rainfall. After day 55 although we had rain for several days the dextran was almost nil. This is because the weather was cool and the low temperature for those days remained below 50 C.

Figure 2 shows the average dextran data plotted versus the high and low temperatures for the season. During the first part of the season the temperature stayed fairly high but cooled down after 50 days of the grinding period.

AVERAGE SUGAR DEXTRAN DATA FOR LOUISIANA

PLOTTED VS AVERAGE RAINFALL

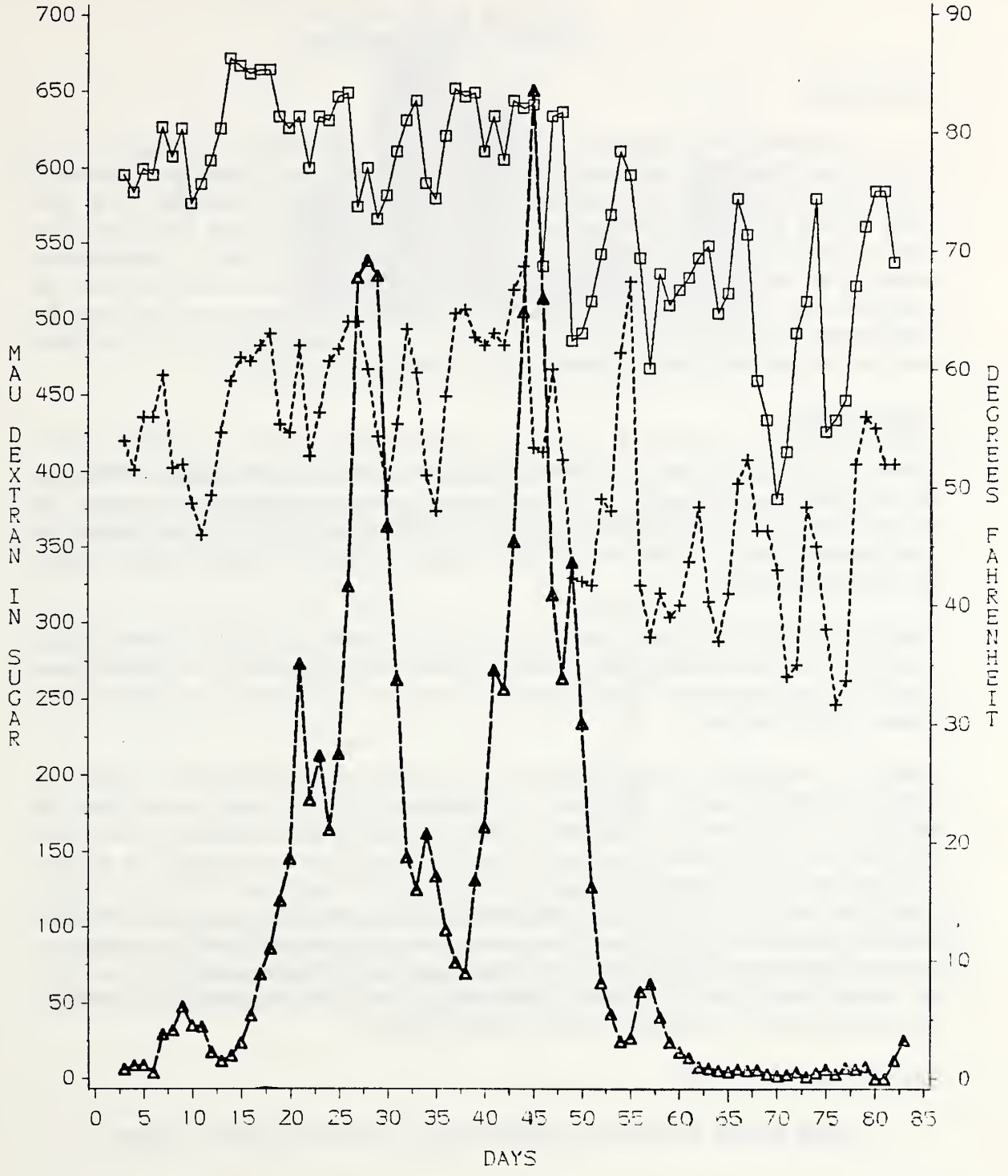


Day 1 corresponds to October 3, 1988

FIGURE 1

AVERAGE SUGAR DEXTRAN DATA FOR LOUISIANA

PLOTTED VS AVERAGE HIGH AND LOW TEMPERATURES



Day 1 corresponds to October 3, 1988

FIGURE 2

Sugar Losses due to Cane Washing

D.F.Day and D. Sarkar
Audubon Sugar Institute

Introduction

The difference between sugar brought to the mill as measured at the core lab and the sugar accounted for after processing has raised the question of what is the magnitude of sugar lost at various stages in processing. One such point where the losses are difficult to determine is on cane washing. This season we attempted to achieve two things. First to obtain a reasonable estimate of how much sugar is lost upon washing cane and second, to determine the difference in loss on washing of cane that goes directly onto the wash table and cane that is first stored in the yard and then put on the table, with the consequent double handling and damage to the cane.

Methodology

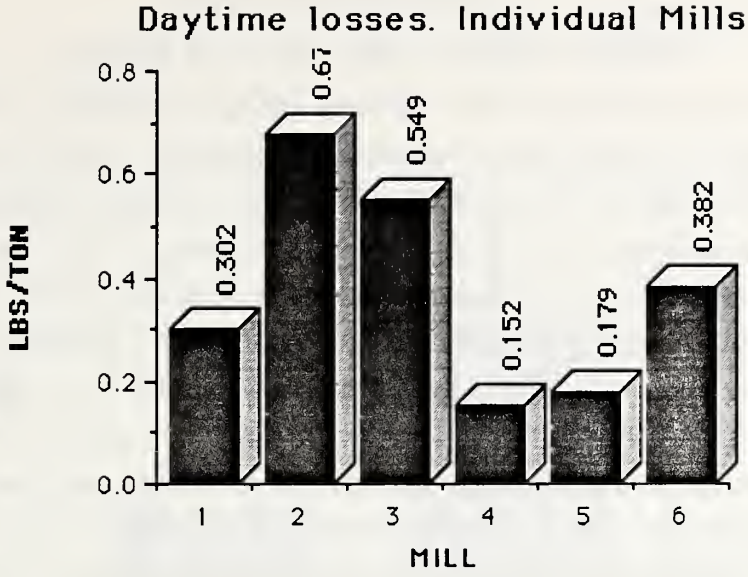
SAMPLE COLLECTION-Two different sets of samples were collected. The first set was individual sampling of daytime operation at six different cane mills. The second set was 6 hr samples taken over a 20 day period at a single sugar mill. Each sample was a paired set of wash water leaving and wash water entering the cane wash table.

SAMPLE PREPARATION-Samples from set one were clarified by centrifugation through a bacteriological filter(Costar Spin-X centrifugal filter - 0.45 um) and those from set two were concentrated 20 fold by evaporation and then stored frozen, until analyzed.

SAMPLE ANALYSIS- Reducing sugar levels were determined using the Nelson-Somogyi test for glucose (1). Reducing sugars levels were taken as indicative of the level of sucrose present, based on the assumptions that the samples were completely inverted by the time they were analyzed, the amount of reducing sugar normally present in fresh cane is very low and there is not a significant amount of sugar lost between sampling and analysis if contaminating microorganisms are removed. Sucrose lost was calculated from the difference between reducing sugar in the water going to the tables and reducing sugar in the water leaving the tables with a correction made for the amount of internal recycling of water at the cane wash table sampled.

Results and Discussion

Sugar losses at several Louisiana sugar mills are shown in below.



The losses are in line with losses reported in a study by Audubon Sugar Institute in 1982 and are shown in the first table.

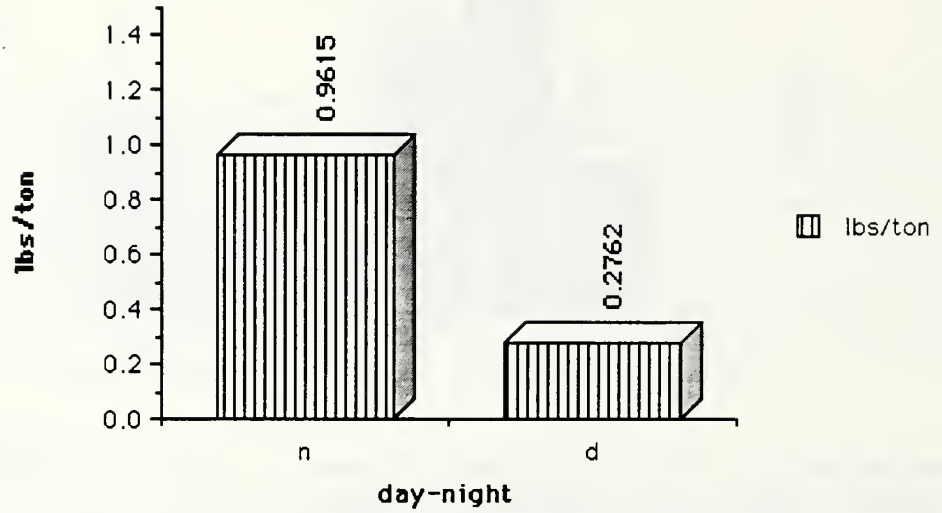
REPORTED SUGAR LOSSES ON CANE WASHING
1982

La. Mill	Pounds/ton
D	0.125
J	1.38
W	1.4
R	0.52
L	4.17
B	2.05

The reported losses are also in the same range as a similar reports on losses on washing of whole stalk sugar cane in Jamaica(2).

Nighttime losses (double handled cane) was three times higher than the losses seen during daytime operation (shown below).

WASH TABLE LOSS DAY VS NIGHT



It is evident that the sugar losses at the cane wash table are not as great as had been speculated, and certainly not in the same range as had been reported for washing forage or chopper harvested cane (up to 5 lbs per ton). The role of damage to the cane in sugar loss is evident from the day-night differential. The night time cane was rehandled using front end loaders, with the consequent increased breakage of cane stalks and subsequent sugar losses.

CRITIQUE- Because of some question over the degree of inversion in the analysis it is not recommended that these values be taken as absolute, however the differences (day-night) and variation seen from mill to mill are undoubtably correct. We hope to resolve the analytical question in the 1989 sugar season and will have a more complete report on various mills at that time.

ACKNOWLEDGEMENTS- We would like to express our appreciation for the aid given to us by the staff of Cora-Texas Sugar Mill

REFERENCES

1.Nelson, N. 1944. J. Biol. Chem. 153: 375-380

2.Roberts, E.V. 1970. J.A.S.T., 21-30

DEXTRANASE PROJECT-SUMMARY

This program is rapidily coming to a close as far as its designed goals, although a number of interesting sidelines have presented themselves and will be pursued if funding is available. Production of dextranase was scaled to 500 l however we did not produced enough for a commercial scale field trial. The studies on the enzymology of the dextranase from *Lipomyces starkeyi* (mutant 1) were completed and are summarized below. The enzyme is similar in composition to and shows identical kinetics to the dextranase from *Chaetomium*, used commercially in Australia. It is a highly stable enzyme, and survives well both long term storage and on exposure to ethanol. This makes it suitable for use in dental care preparations as well as sugar use. Induction of the enzyme is commercially feasible using a small amount of dextran at a specific point in the growth cycle. Temperature stability in sugar solutions is lower that that reported for buffer solutions. This dictates that any sugar industry application will have to be at the juice rather than the syrup stage.

The enzyme selected turned out to be one of a series of isozymes each with dextranase activities. We propose to extend our investigations in this area to see if there are other isozymes with potential commercial interest. This *Lipomyces* also produces considerable neutral lipid during the course of the fermentation. We plan also on investigating the utility of this material in food processing

LIPOMYCES DEXTRANASE PROPERTIES

PHYSICAL PARAMETERS

Size - between 68 and 74,000

pI - between 5.6 and 6.1

pH Optimum-5.0

Temp Optimum- 55 ^{o}C

Glycoprotein -8% CHO

STABILITY

Opt. Temp -30 °C

Opt. pH - 5.0

Protease sensitivity- insensitive to pepsin, papain and trypsin, slowly inactivated by ficin

CATALYTIC PROPERTIES

Ion sensitivity-sensitive to Cuprous, Ferrous and Mercuric ion

Inactivated by SDS

Km- (T-2000) 0.004 mM

End products of reaction-isomaltotriose and isomaltose

PRODUCTION

Current yields, Dextran-4 IU/ml, Glucose (plus inducer) 2 IU/ml

Costs of production / unit (current)
Dextran - 0.016 ¢
Glucose - 0.0076 ¢

UTILIZATION

At level of first mill, 10 min holding time, to reduce sugar reading by 250 MAU, 1752 units/ gal
Cost estimate 17 ¢ per lb of sugar

Prospects - current microbiol techniques should be able to reduce the cost of production 100 X, a doubling of the holding time will halve the cost. A commercial operation should be able to supply dextranase around 0.2 ¢ per lb of sugar treated.

1988 CORE SAMPLING

by

H. S. Birkett and J. Stein

Some of the results obtained during the 1988 crop core lab study are summarized below:

1. The present core lab procedures predict about 3-5 % more pol in cane than actually present in the delivered (gross) cane.

2. The pol extraction achieved by the hydraulic press is typically 80%.

3. The true (cane) fiber in the delivered (gross) cane typically averages about 10.5 to 11%.

4. The sediment factor presently used (0.302) is reasonable provided that the samples are centrifuged for 10 minutes at the highest speed.

5. The drying of the press residue moisture samples may not be complete. The tests indicate that 2-1/2 hours at 150 deg. C is required for some ovens.

6. The direct determination of the Brix in cane and Brix in residue by a precision refractometer appears to be inaccurate, and further work in sample preparation is necessary.

Table 1

POL IN CANE - CORE, BLENDOR, CORE JUICE + BAGASSE ANALYSIS

Run Number	Pol % Cane			Pol % Cane as % J+B Pol % Cane		
	Core Lab	Blendor	Core J+B	Core Lab	Blendor	Core J+B
1	12.20	10.74	12.11	100.76	88.73	100.00
2	13.74	13.00	13.43	102.31	96.77	100.00
3	13.55	12.95	13.26	102.15	97.63	100.00
4	12.30	11.56	12.07	101.98	95.80	100.00
5	13.23	12.65	12.53	105.55	100.94	100.00
6	13.35	12.57	13.10	101.88	95.95	100.00
7	12.61	11.86	12.27	102.84	96.71	100.00
8	14.92	14.35	14.46	103.21	99.23	100.00
9	11.72	10.87	11.06	105.94	98.27	100.00
10	11.80	11.11	11.08	106.47	100.24	100.00
11	13.74	13.53	13.25	103.68	102.10	100.00
12	10.60	10.41	10.34	102.53	100.63	100.00
13	12.95	13.04	12.82	100.99	101.73	100.00
14	13.76	13.68	13.19	104.30	103.71	100.00
15	10.77	10.45	10.44	103.21	100.11	100.00
16	12.58	12.09	11.76	107.03	102.88	100.00
17	10.39	9.69	10.05	103.46	96.40	100.00
18	10.49	9.94	10.04	104.49	99.02	100.00
19	14.23	13.46	13.82	102.94	97.40	100.00
20	12.94	11.90	12.46	103.87	95.52	100.00
21	13.74	13.02	13.01	105.62	100.12	100.00
22	13.66	13.08	13.40	101.95	97.61	100.00
23	14.39	14.21	13.64	105.47	104.14	100.00
Avg.	12.77	12.18	12.33	103.59	98.77	100.00

Core Lab Pol % Cane is current calculated figure with sediment determination.

Blendor Pol % Cane is direct pol % cane obtained by disintegrating a portion of the core sample in a Waring blendor.

Core (J+B) Pol % Cane figure is calculated pol in cane using the core juice combined with a direct pol determination on the residue (by disintegration).

Results indicate that the core press method slightly overpredicts the true pol % cane (by 3 to 5%). i.e. when the core lab indicates a pol % cane of 12.77%, the true pol % delivered cane is 12.18 to 12.33%.

Table 2

BRIX IN CANE - CORE, BLENDOR, CORE JUICE + BAGASSE METHODS

Run Number	Brix % Cane			Brix % Cane as % J+B Brix % Cane		
	Core Lab	Blendor	Core J+B	Core Lab	Blendor	Core J+B
1	13.10	13.04	13.74	95.36	94.91	100.00
2	14.75	14.94	14.70	100.34	101.59	100.00
3	15.16	15.92	15.29	99.17	104.11	100.00
4	13.91	14.40	14.10	98.65	102.16	100.00
5	15.00	15.53	14.95	100.28	103.83	100.00
6	15.17	15.51	15.31	99.09	101.32	100.00
7	14.24	14.37	14.35	99.18	100.09	100.00
8	16.09	16.94	16.22	99.16	104.38	100.00
9	13.55	14.64	13.72	98.74	106.69	100.00
10	13.30	14.30	13.52	98.38	105.77	100.00
11	14.94	16.29	15.28	97.80	106.66	100.00
12	12.40	13.31	12.67	97.91	105.06	100.00
13	14.73	15.82	14.97	98.42	105.66	100.00
14	15.45	16.41	15.27	101.18	107.48	100.00
15	13.14	13.64	13.17	99.78	103.56	100.00
16	14.92	15.35	14.44	103.30	106.28	100.00
17	13.27	13.31	13.27	100.00	100.30	100.00
18	13.15	13.34	13.00	101.16	102.65	100.00
19	14.98	15.85	15.30	97.94	103.60	100.00
20	14.58	14.63	14.54	100.29	100.67	100.00
21	15.34	15.98	14.95	102.63	106.92	100.00
22	15.19	16.01	15.56	97.65	102.90	100.00
23	15.96	16.88	15.53	102.77	108.65	100.00
Avg.	14.45	15.06	14.52	99.53	103.71	100.00

Core Lab Brix % Cane is current calculated figure with sediment determination.

Blendor Brix % Cane is direct Brix % cane obtained by disintegrating a portion of the core sample in a Waring blendor and using a precision refractometer to determine the Brix of the extract.

Core (J+B) Brix % Cane figure is calculated Brix in cane using the core juice combined with a direct Brix determination of the residue Brix by disintegration).

Note: The Brix % extract (for both the blendor method and residue analysis) appear to be higher than the correct value. Thus the Blendor Brix % cane and to a lesser extent the J+B Brix % cane are higher than the True Brix % cane.

Table 3

FIBER + 'ASH' IN CANE - CORE, BLENDOR, CORE JUICE + BAGASSE METHODS

Run Number	Core Lab	Blendor	Core J+B	Expressed as % of J+B Figure		
				Core Lab	Blendor	J+B
1	26.60	27.66	25.90	102.72	106.81	100.00
2	20.68	24.65	18.77	110.16	131.30	100.00
3	12.35	14.16	11.25	109.80	125.86	100.00
4	21.44	23.70	20.49	104.60	115.62	100.00
5	14.79	16.06	14.06	105.23	114.23	100.00
6	13.31	13.00	12.23	108.80	106.22	100.00
7	15.25	16.41	15.09	101.10	108.76	100.00
8	14.42	14.37	13.38	107.77	107.33	100.00
9	15.32	14.42	13.83	110.76	104.24	100.00
10	21.30	18.38	19.81	107.53	92.76	100.00
11	18.36	16.95	15.74	116.61	107.67	100.00
12	15.62	16.03	14.66	106.54	109.34	100.00
13	15.81	15.95	15.01	105.33	106.23	100.00
14	16.03	14.25	15.32	104.67	93.02	100.00
15	16.85	17.42	15.86	106.28	109.83	100.00
16	14.75	15.29	15.31	96.33	99.83	100.00
17	14.37	15.01	14.03	102.38	106.92	100.00
18	16.78	17.92	16.45	102.03	108.92	100.00
19	17.69	18.34	15.36	115.20	119.44	100.00
20	17.64	17.63	17.26	102.16	102.13	100.00
21	17.09	17.40	16.59	103.02	104.91	100.00
22	17.88	17.53	16.91	105.71	103.65	100.00
23	12.76	12.18	12.71	100.42	95.84	100.00
Avg.	16.83	17.16	15.91	105.88	107.86	100.00

Core lab figure is fiber plus dry sediment as calculated by more method.

Blendor method figure is true fiber plus true ash.

Core (J+B) figure is true fiber plus true ash in bagasse residue, but does NOT include ash in the extracted juice.

Note: The above three tabulations do NOT represent the same quantities.

Table 4

TRS BY THREE METHODS - CORE, BLENDOR, CORE JUICE + BAGASSE ANALYSIS

Run Number	Core Lab	Blendor	Core J+B	Expressed as % of J+B Figure		
				Core Lab	Blendor	J+B
1	188.10	153.88	183.69	102.40	83.77	100.00
2	227.30	199.08	224.57	101.22	88.65	100.00
3	237.47	213.26	231.18	102.72	92.25	100.00
4	197.20	171.74	192.18	102.62	89.36	100.00
5	225.72	204.98	209.78	107.60	97.71	100.00
6	230.41	208.60	225.04	102.39	92.69	100.00
7	214.89	193.02	205.58	104.53	93.89	100.00
8	261.55	240.97	251.00	104.20	96.01	100.00
9	197.17	169.34	181.73	108.50	93.18	100.00
10	189.68	171.61	173.89	109.08	98.69	100.00
11	231.42	219.79	222.53	103.99	98.77	100.00
12	176.95	164.93	169.91	104.15	97.07	100.00
13	218.59	212.97	215.23	101.56	98.95	100.00
14	233.26	227.99	221.80	105.17	102.79	100.00
15	173.97	161.57	166.96	104.20	96.77	100.00
16	210.12	193.79	191.75	109.58	101.07	100.00
17	167.28	148.21	158.94	105.25	93.25	100.00
18	166.95	150.36	157.33	106.12	95.57	100.00
19	244.57	218.29	237.41	103.02	91.95	100.00
20	215.97	189.99	205.11	105.29	92.63	100.00
21	231.37	208.53	217.07	106.59	96.06	100.00
22	228.73	209.40	221.76	103.14	94.43	100.00
23	252.40	242.18	236.49	106.73	102.41	100.00
Avg.	213.96	194.54	204.39	104.78	95.13	100.00

TRS figures for the three methods calculated using the respective pol % cane, and Brix % cane, and fiber + ash figures shown in Table 3, and applying the core method formula.

Table 5

ABSOLUTE JUICE PURITY - CORE, BLENDOR, CORE JUICE + BAGASSE ANALYSIS METHODS

Run Number	Core Lab	Blendor	Core J+B	As percentage of J+B Figure		
				Core Lab	Blendor	J+B
1	93.10	82.38	88.12	105.66	93.49	100.00
2	93.14	87.00	91.34	101.97	95.25	100.00
3	89.35	81.35	86.74	103.01	93.78	100.00
4	88.48	80.26	85.59	103.38	93.77	100.00
5	88.19	81.45	83.79	105.25	97.21	100.00
6	87.98	81.04	85.57	102.82	94.71	100.00
7	88.60	82.55	85.44	103.69	96.62	100.00
8	92.76	84.73	89.13	104.08	95.06	100.00
9	86.48	74.24	80.60	107.29	92.11	100.00
10	88.73	77.70	81.99	108.23	94.77	100.00
11	91.97	83.05	86.75	106.01	95.73	100.00
12	85.49	78.19	81.63	104.73	95.78	100.00
13	87.87	82.45	85.63	102.62	96.29	100.00
14	89.04	83.35	86.37	103.08	96.49	100.00
15	82.00	76.63	79.27	103.44	96.67	100.00
16	84.34	78.80	81.40	103.61	96.80	100.00
17	78.31	72.75	75.70	103.45	96.11	100.00
18	79.77	74.50	77.23	103.29	96.47	100.00
19	94.96	84.94	90.36	105.10	94.01	100.00
20	88.78	81.34	85.72	103.57	94.89	100.00
21	89.57	81.50	87.03	102.91	93.64	100.00
22	89.91	81.68	86.11	104.41	94.86	100.00
23	90.14	84.19	87.83	102.63	95.85	100.00
Avg.	88.22	80.70	84.75	104.10	95.23	100.00

Core lab "absolute juice" same as extracted juice purity.

Blendor absolute juice is directly determined from pol and Brix of extract after disintegrating sample in Waring blendor.

Core J+B absolute juice calculated from extracted juice analysis and residual juice analysis by disintegrating residue in Waring blendor.

Note: Overestimation of Brix noted earlier yields absolute juice purities for the Blendor and J+B method (to a lesser extent) that are lower than expected.

Table 6

ASH IN CANE AND BAGASSE AND ASH RETENTION IN RESIDUE

Run Number	Blendor Ash % Cane	Core Residue Ash % Residue	Core Residue Ash % Cane	Core Residue Ash Retention
1	17.66	40.72	16.07	90.99
2	14.46	27.23	9.50	65.66
3	3.72	9.36	2.45	65.95
4	12.91	29.84	10.95	84.83
5	4.70	8.60	3.12	66.40
6	2.50	5.86	1.79	71.42
7	5.11	11.95	4.09	80.03
8	3.61	8.67	2.88	79.30
9	3.88	7.48	2.66	68.55
10	7.72	19.24	9.03	116.94
11	6.88	14.08	5.42	78.81
12	6.06	9.93	4.08	67.35
13	6.95	16.01	4.79	68.88
14	4.73	12.49	3.83	81.07
15	7.44	15.88	4.83	64.89
16	2.84	4.84	1.64	57.60
17	4.44	9.05	2.59	58.30
18	6.56	14.82	4.40	67.10
19	7.48	10.56	4.37	58.45
20	7.83	17.14	6.03	77.05
21	7.21	15.49	4.52	62.73
22	4.93	7.43	2.88	58.32
23	2.69	6.88	1.93	71.61
Avg.	6.62	14.07	4.95	72.30

Blendor Ash % Cane is obtained by ashing a sample of the cane core.

Core Ash % Residue is obtained by ashing a sample of the residue.

Ash % Cane from core residue is obtained by multiplying the ash % residue figure by the residue % cane.

Ash retention is the core's ash % cane figure expressed as a percent of the Blendor's ash % cane figure.

Table 7

COMPARISON OF TRUE (DIRECT) FIBER IN CANE - BLENDOR VS RESIDUE

Run Number	Blendor	Core Residue	Blendor % Core Residue
1	10.00	9.83	101.73
2	10.19	9.28	109.82
3	10.44	8.79	118.67
4	10.79	9.54	113.03
5	11.36	10.94	103.86
6	10.50	10.45	100.45
7	11.30	11.00	102.74
8	10.76	10.50	102.43
9	10.54	11.17	94.32
10	10.66	10.78	98.82
11	10.07	10.32	97.57
12	9.97	10.58	94.23
13	9.00	10.22	87.99
14	9.52	11.48	82.89
15	9.98	11.03	90.44
16	12.45	13.68	91.00
17	10.57	11.45	92.31
18	11.36	12.05	94.26
19	10.86	10.98	98.88
20	9.80	11.23	87.28
21	10.19	12.06	84.48
22	12.60	14.04	89.77
23	9.49	10.78	88.01
Avg.	10.54	10.96	96.74

Blendor true fiber in cane obtained by straining, washing and drying the blended cane sample after disintegration in the blendor.

True fiber % cane from Core Residue determined by direct determination of the true fiber in the residue by straining, washing and drying the residue sample after disintegration in a blendor. The true fiber content in the cane being obtained from the product of the true fiber % residue and the residue % cane.

The results indicate that the true cane fiber % delivered (gross) cane typically averages 10.5 to 11.0%.

Table 8

COMPARISON OF PRESS JUICE PURITY WITH RESIDUAL JUICE PURITY

Run Number	Press Juice	Residual Juice	Difference	Press Extraction
1	93.10	71.06	22.05	81.77
2	93.14	83.31	9.83	83.33
3	89.35	73.95	15.41	85.56
4	88.48	75.02	13.46	81.18
5	88.19	70.91	17.28	78.44
6	87.98	76.45	11.53	81.30
7	88.60	75.25	13.35	79.18
8	92.76	77.04	15.72	79.99
9	86.48	63.41	23.07	79.97
10	88.73	69.53	19.21	70.22
11	91.97	72.82	19.15	77.14
12	85.49	73.51	11.98	70.99
13	87.87	75.79	12.08	83.58
14	89.04	73.53	15.50	85.39
15	82.00	65.93	16.07	85.87
16	84.34	69.69	14.65	82.82
17	78.31	62.81	15.50	86.00
18	79.77	62.85	16.92	87.78
19	94.96	80.73	14.24	71.07
20	88.78	75.09	13.70	80.41
21	89.57	69.91	19.66	89.65
22	89.91	76.08	13.83	75.75
23	90.14	75.34	14.80	86.61
Avg.	88.22	72.61	15.61	81.04

Press Juice purity is the purity of the extracted press juice.

Residual Juice purity is the purity of the juice in the residue determined by disintegrating the press residue and determining the pol and Brix of the extract.

Note: The residual juice purity of the residue was obtained from the Brix of the extract, and the Brix is believed to be too high yielding too low a residual juice purity.

Press extraction is the actual pol extraction of the press calculated from the pol in the extracted press juice divided by the pol in the extracted press juice plus the pol in the residue obtained by direct analysis of the residue.

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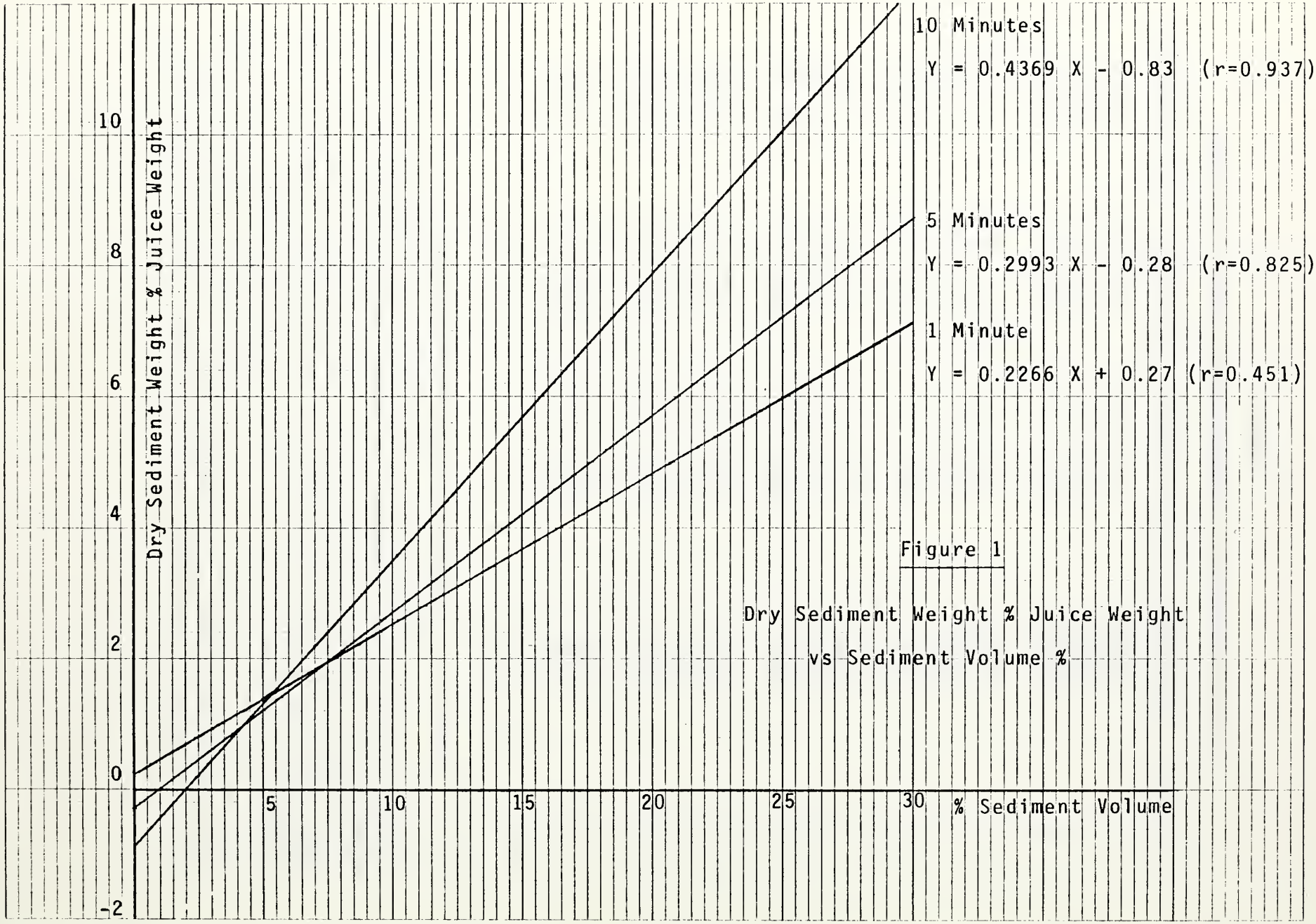

Figure 1

Dry Sediment Weight % Juice Weight
vs Sediment Volume %

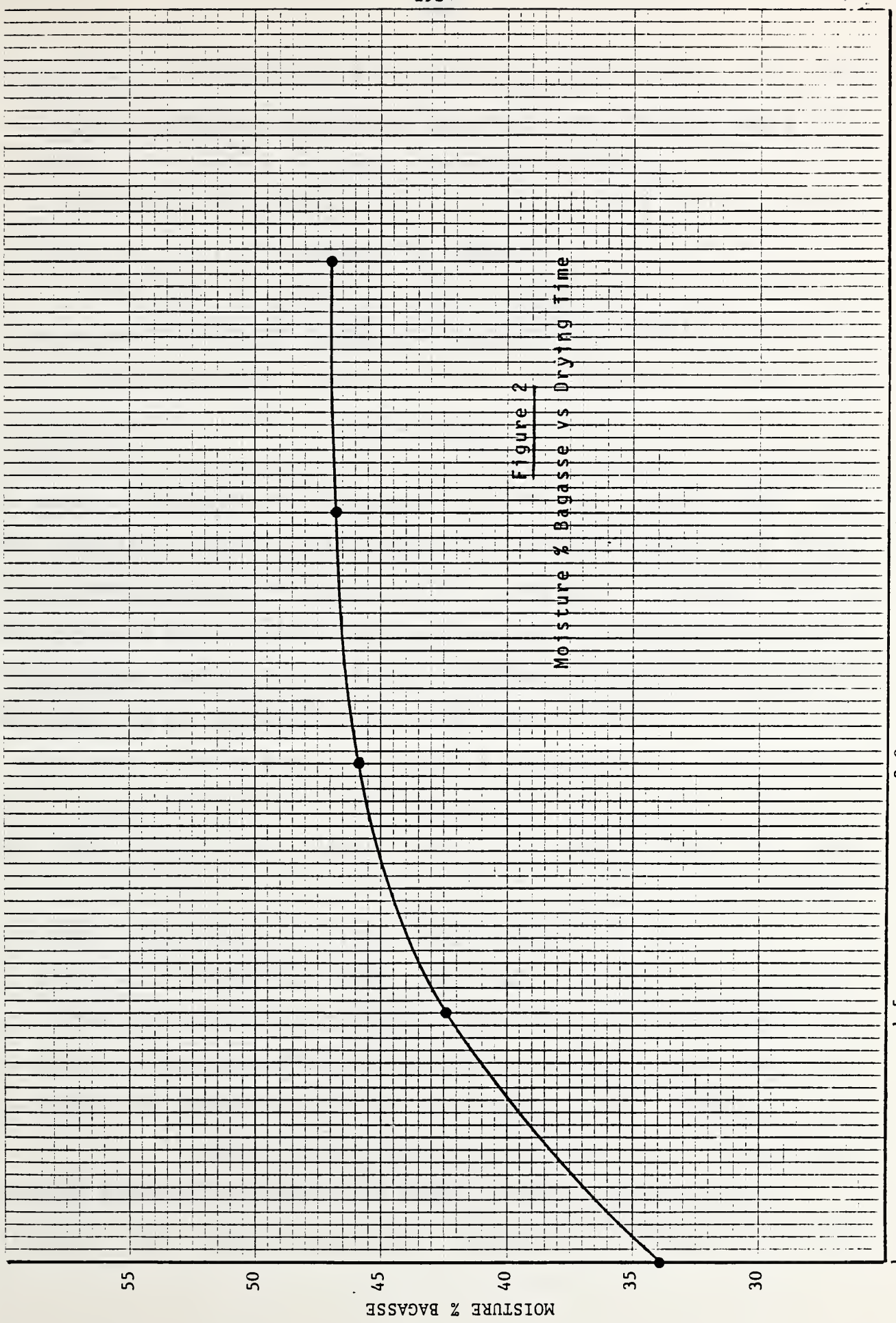

Figure 2

Moisture % Bagasse vs Drying Time

FINAL REPORT TO THE AMERICAN SUGAR CANE LEAGUE ON PROJECT "QUICK CORE LABORATORY TEST FOR DEXTRAN"

STEPHEN J. CLARKE

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INTRODUCTION

This project was funded by the American Sugar Cane League in 1987 and 1988 to develop an analytical procedure suitable for determination of dextran in the juice from the cane sampled in the core laboratory. The test procedure should make possible the analysis of all cane samples to let the factory management know the sources of dextran and the levels of dextran to be expected in process. Compositing of samples was considered undesirable. Although fairly rapid tests for dextran do already exist, they are not quantitative and the sought after test must be quantitative.

A copy of the progress report for work performed during the 1987 crop is attached. The almost ideal harvesting conditions in that year limited the factory data that could be obtained. In the 1987 work, the basic features of the analytical procedure were decided. The background to the procedure and typical calibration curves, etc., are given in that report.

A nephelometric method, based on interaction between dextran and an antibody to dextran, was chosen as the most suitable

procedure. Two sources of antibody were identified - (i) a sheep polyclonal antibody formed against a dextran bovine serum albumen complex and (ii) a mouse monoclonal antibody formed against dextran alone and prepared specifically for this work. Neither source is really commercial but could become so if necessary.

Most of the work to date is based on the use of the polyclonal antibody since it demonstrated higher sensitivity, i.e., the instrument response to the same quantity of dextran was higher and the results therefore more reliable. The monoclonal material is recommended for the factory procedure. Comparative data for dextran in raw sugars with this antibody and other procedures have been obtained and are to be published in the sugar literature. There is good correclation between the haze test for dextran in raw sugar and the monoclonal antibody procedure and the new test may provide an easy way to monitor the dextran level in sugar as it is produced.

RESULTS

Although the basic analytical scheme was fixed in the 1987 work, several crucial steps remained to be decided -

1. What pretreatment of the juice is necessary?
2. Can the quantity of antibody be reduced to lower costs?
3. How simple can the procedure be?
4. Can the procedure keep pace with the core laboratory?
5. How is the data from the test to be used?
6. What is the cost of each analysis?

Each of these questions have been answered and are discussed separately.

Juice Pretreatment

The inherent turbidity of the press juice causes a higher than desirable background and could be a significant source of error. It was hoped that the centrifugation of the juice for the mud sediment test would give juice of sufficient clarity, but this was not always the case. A membrane filter attached to to a syringe was necessary to obtain a consistently low background. Various pore size filters were tried and, as expected, the smallest pore size gave the lowest background, but also the slowest filtration rate, often too low to be practical. The filter pore size which gave adequate flow rates and acceptable background was 1.2 micron and this was used for subsequent studies and is part of the recommended procedure.

Antibody Quantity

The originally proposed procedure involved the use of 2 ml of diluted antibody reagent per test but this made the cost higher than desirable. A modified sample holder was constructed for the Hach Ratio Turbidimeter to hold narrow tubes with a sample volume of only 1 ml, thus reducing the cost to half. The instrument manufacturer has been contacted with regard to supply of the modified sample holder and tubes.

Procedure Simplicity

The procedure has been simplified as far as possible to minimize the number of operations involved. The antibody

concentrate is stable in the freezer for at least a year and the diluted reagent (in phosphate saline buffer solution) is stable for several days if stored in the refrigerator. The diluted reagent must be filtered before use (through a GF/F glass fiber filter) and the filtred reagent stored in the refigerator for longer than a day should be refiltered to reduce the background. The reagent must be allowed to warm to room temperature before use. The glass tubes used in the nephelometer must be scrupulously clean.

1 ml of the antibody reagent is pipetted into the tube with an automatic pipette. After wiping, the tube is inserted into the nephelometer to determine the background reading. If the background reading exceeds about 0.7 NTU, then the cleanliness of the tube must be checked or the reagent solution refiltered. 10 microlitres of the filtered juice is added to the reagent solution with an automatic pipette, the tube is sealed with parafilm, inverted a few time to ensure mixing, wiped and inserted into the instrument. The reading is taken after about three minutes; if there is little or no response, the dextran level is very low and the test may be stopped.

If the tubes are all the same, the background should be constant and it is not necessary to take a blank measurement in each case.

Reading for sample (NTU) = NTU of sample - NTU of blank

Rapidity of Procedure

No problem was found in keeping up with the core laboratory at Raceland, 70 samples being run by one person in two and a half

hours in one case. The tubes containing reagent can be prepared beforehand. The most time-consuming step is often the filtration and the membrane containing filter assemblies can also be prepared in advance.

Calculation of Dextran Level

A previously prepared calibration curve against standard dextran is used to calculate the concentration of dextran in each sample from its NTU value. Standard samples should be occasionally interspersed between the unkown juice samples to ensure that consistent readings are obtained. Little variation in the slope of the standard curve was noted over the whole study and a calibration curve prepared at the beginning of each crop should be sufficient.

An example of the calculation procedure is given -
From the calibration curve, the ratio of dextran concentration expressed as ppm on juice is 42.

ppm dextran on juice = (NTU value) x 42

ppm dextran on brix = (NTU value) x 42 x 100 / (juice brix)

The juice brix is the value determined in the routine core analysis. The expression of the dextran concentration in terms of solids is considered preferable since it gives the results in terms of the amount of material to be processed.

Typical data (from Raceland - November 30, 1988)

Sample number	NTU blank	NTU with juice	NTU value	Juice brix	ppm dextran on juice	ppm dextran on brix
5	0.40	1.16	0.76	22.1	32	144
65	0.52	3.15	2.63	17.7	110	620
66	0.58	3.39	2.81	19.8	118	596
75	0.56	0.96	0.40	21.1	17	80
364	0.71	7.68	6.97	17.3	293	1692
366	0.54	0.93	0.39	20.5	16	80
378	0.80	3.25	2.45	17.5	103	588

There still remains in doubt the value of the dextran concentration in juice which will cause penalty levels in raw sugar. Preliminary data suggest that dextran levels above 1,000 to 1,200 cause problems. In this case, only sample 364 would produce penalty level sugar and samples 65, 66 and 378 are cause for concern.

The inherent errors in the system give a standard deviation of about 10% for repetitive samples and, if used for determination of penalties on cane deliveries, this must be taken into account. Although the test is reliable and quantitative, its use in awarding penalties remains to be settled.

Cost per Analysis

The capital costs of the analysis are for the instruments, pipettes, filter assemblies and sample tubes. It is estimated that the total cost for this is about $1,600. Assuming 100 analyses per day for half the crop, this becomes about $0.40 per analysis if the equipment cost is charged completely against the

first year's operation. For the research project the cost of antibody reagent per analysis was $0.80 and $0.30 per membrane filter, giving a total of $1.10 per analysis for consumables and an overall total of $1.50 per analysis. Bulk purchase of the reagent by a central organization such as the ASCL would reduce the cost to abou $0.30 per analysis, with a total cost of about $1.00. The personnel costs are not included in these calculations.

SUMMARY

A rapid method for dextran analysis has been developed which is very suitable for use in the core laboratory. At this stage the ASCL and the individual mills must decide how to proceed in the implementation of the procedure, especially with regard to purchase of the reagent.

Evaporator Scaling Studies

Stephen J. Clarke
Audubon Sugar Institute

Two pilot scale evaporators, run in parallel, have been designed, fabricated and operated to monitor scale formation in the evaporators. Due to the difficulty of operating under reduced pressure, evaporation of the factory clarified juice takes place at atmospheric pressure with the flow and evaporation rates set to be equivalent to the first effect of a multiple effect evaporator.

One unit contains four tubes, each 1200 mm long and 19 mm diameter, which are removed at the end of each run and weighed. Each tube is fed with juice at the same rate, but can be fed independently with antiscalants or any other treatment. The second unit contains two sections which allow sheet metal, e.g. copper or stainless steel, to be used as the heat transfer medium, the heating surface being 600 mm by 40 mm. As with the first unit, each section is fed with juice at the same rate and can be chemically treated independently.

Uneven flow of juice into the system made measurement of evaporation rates difficult, but the qualitative data obtained to date show that most commercially available antiscalents used have adverse effects on the metal surface, producing greater deposition. The materials deposited are being studied for their composition and microstructure, by electron microscopy. Preliminary data suggest that the scale formed from untreated juice is predominantly crystalline and that the use of antiscalants, typically polycarboxylic acid salts, e.g. polymaleic acid, results in amorphous deposits. Perhaps more significant is the much higher level of silica in the scale formed with treated juice.

Purification of Sugarcane Process Streams

Stephen J. Clarke
Audubon Sugar Institute

Purification of sugarcane process streams involves a variety of unit operations and several of these have been studied. Precipitation of non-sugars, including color precursors, has been achieved with chemicals used for potable water production. The experimental techniques necessary for evaluation of these methods have been developed. Particularly promising are treatments using polymeric quaternary amines, three of which work well and one, unexpectedly, poorly. Simple quaternary amines containing long chain aliphatic groups have mixed performance and require higher concentrations. To study the effect of anionic detergents, reported to be model compounds for those formed in stale cane, several long chain carboxylic and sulfonic acid sales were evaluated. However, adverse effects were only observed, with Louisiana cane, at higher concentrations than reported in the literature.

A laboratory scale vacuum pan cum cooling crystallizer has been constructed to continue the study of more efficient sugar recovery involving the use of non-volatile water miscible organic solvents. Methods for removal of residual quantatives of these solvents, primarily by adsorption on solid polystyrene beads, have been developed, and work well. Two phase purification of low purity streams, e.g. B-molasses, has been achieved with non-volatile organic solvents. In this case solvent recovery is based on the separation of phases achieved by raising the temperature.

Vacuum Pan Automation.

Bill Keenliside.

Audubon Sugar Institute.

Introduction

Investigations of the control of vacuum pans has been in progress for two years. The major focus of the program has been to study the compatability of a range of pan sensors. The sensors which have been investigated are:-

Consistency/Viscosity
Supersaturation
Molasses Brix
Low Frequency Conductivity
Radio Frequency Conductivity

This report summarises the major conclusions of the work and indicates those systems which are applicable to local conditions.

Sensor Systems

Consistency measurement has become the most commonly used sensor system in Louisiana. The technique is based on the measurement of the current to a motor which is attached to a paddle rotating in the massecuite. Apart from the inherent problems in correlating the sensor signal with massecuite properties, mechanical difficulties also exist. The main problem with the sensor is in the ceramic bearings which are used on the shaft of the paddle. These bearings frequently break up or wear such that the shaft no longer rotates freely.

The principal of operation of the consistency monitor is that the current to the motor is directly related to the viscosity of the massecuite. In fact the current may be related to the torque on the shaft of the motor, but since the motor does not rotate at a constant speed the torque cannot be related to the viscosity. Hence it is not possible to correlate the motor load to the massecuite properties.

The viscosity of a massecuite, as measured by a rotating sensor,is a function of molasses brix, crystal content, temperature and rotational speed. Since it can be assumed that the temperature is relatively constant, the major effects are dependant on molasses properties and speed. Neither the brix nor crystal content are known and thus the torque cannot be related to the massecuite properties.

Figure 1 shows three profiles for B strikes controlled by conductivity. In these graphs the consistency variations are independant of the conductivity and the final massecuite brix. Clearly, the sensitivity of the consistency system leaves a lot to be desired and offers little hope as a control parameter.

Torque measurements based on the load to a pan stirrer may be better than the consistency sensor since the stirrer operates at a constant speed.The current to the stirrer reflects the level of the massecuite in the pan rather than the "brix" of the massecuite and hence is a reliable monitor for the strike level in the pan. Tightening the pan at the end of the strike based on stirrer power may be useful but is not suggested as the ultimate sensor.

Molasses brix determination during strikes has been investigated, but this technique shows promise only in the area of grain strikes. With known purity materials, (70 -90), the brix at which the material should be grained is easy to determine. An on-line refractometer in the pan can therefore be used to determine the graining point with reasonable accuracy. After the grain has been injected and begins to appear, interference on the surface of the prism due to crystals in the massecuite frequently masks the measurement of liquor brix. Furthermore, without extensive modifications to the refractometer, the limit of the instrument is between 85 to 88 brix. This value is much lower than normally found in commercial strikes and thus limits the usefulness of this method.

Low frequency conductivity, below 50 kHz, has been used with only limited success, since it suffers from a lack of sensitivity and problems associated with the fouling of the electrode.

During the course of the study, two specific methods have been the main focus of attention, namely supersaturation and radio-frequency conductivity.

The use of supersaturation as a means of monitoring the condition of the mother liquor offers the most reliable technique for controlling vacuum pans. This method is the only available technique which can measure massecuite parameters directly, since other techniques infer massecuite properties by correlation analysis.

To measure the supersaturation the data required are, massecuite temperature, absolute pressure and liquor purity. While the temperature and pressure are easily measured, the molasses purity has to be determined from a knowledge of the feed purity and the level of the maassecuite in the pan.

Studies of the utilisation of this method for low grade boilings indicate how the purity of the mother liquor varies with height in the pan and more recent studies show that similar trends exist for high grade pans.

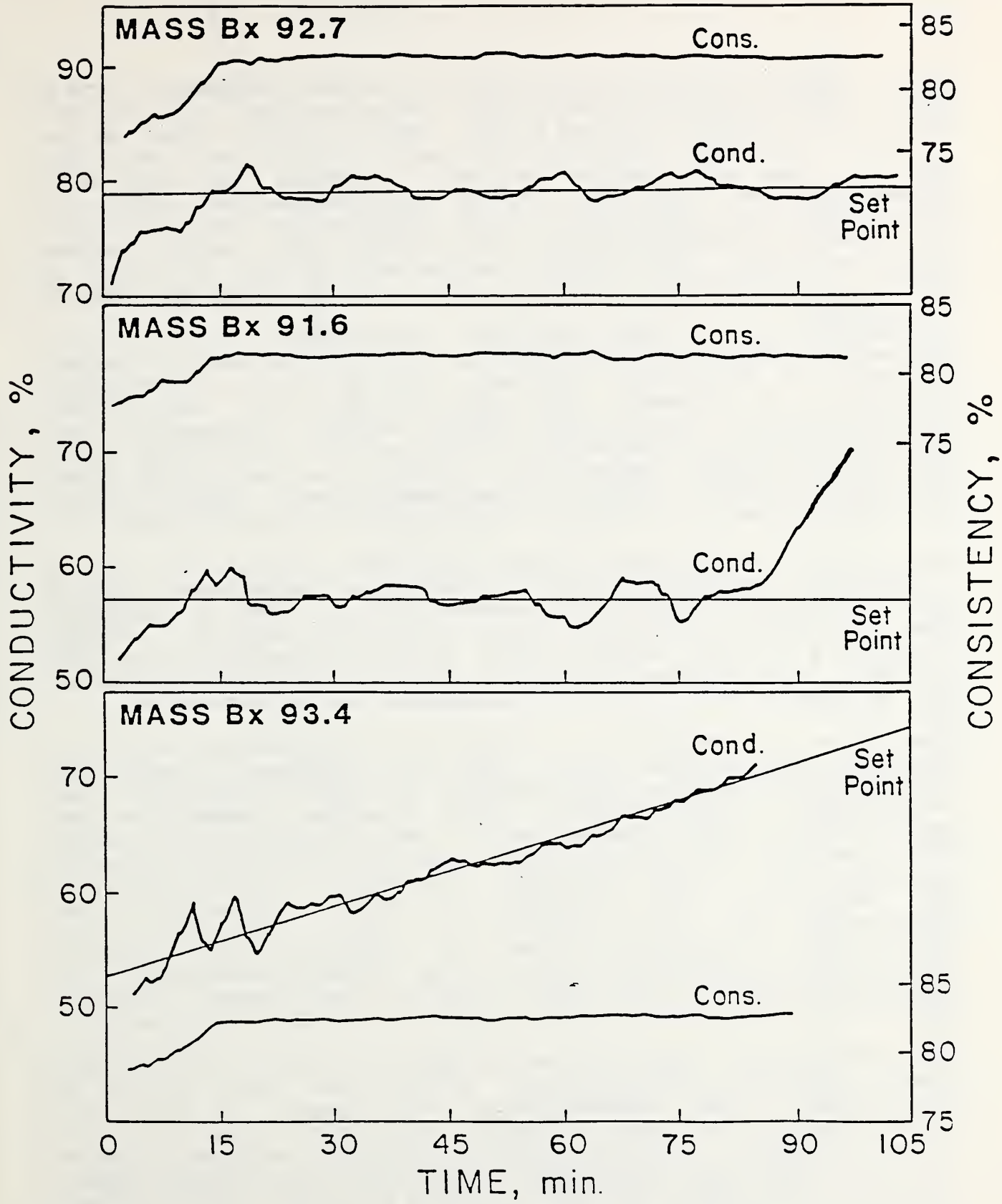

MASS Bx 92.7
Cons.
Cond.
Set Point
MASS Bx 91.6
Cons.
Cond.
Set Point
MASS Bx 93.4
Cond.
Set Point
Cons.
CONDUCTIVITY, %
CONSISTENCY, %
TIME, min.
0
15
30
45
60
75
90
105
70
80
90
50
60
70
75
80
85

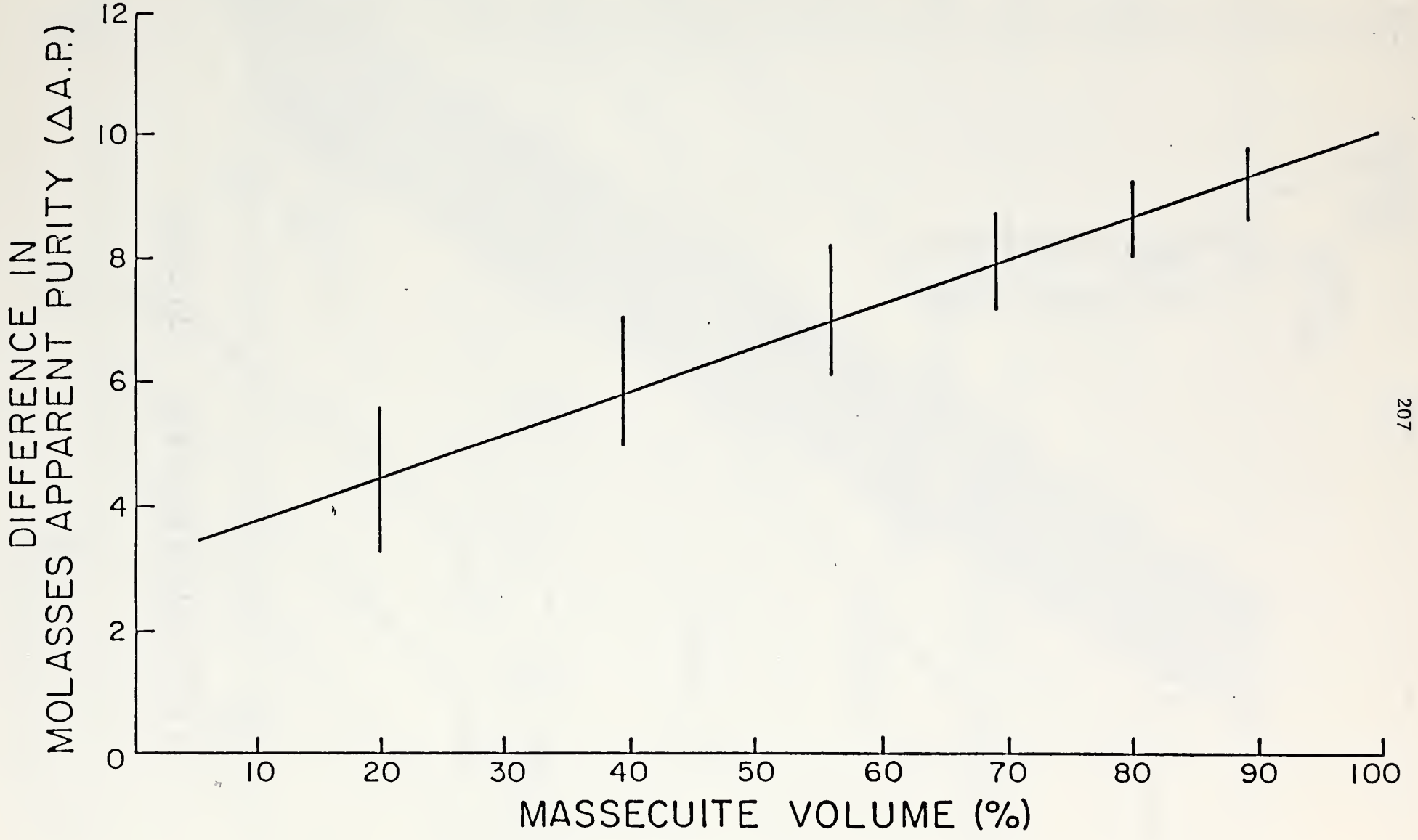
FIGURE 1.

Typical massecuite purity profiles are shown in figures 2 and 3 for C and A strikes respectively. These profiles represent the difference between the feed purity and the mother liquor in the pan as a function of massecuite level. Since the trends are linear they can readily be used to adjust the calculated supersaturation during the strike, provided a level sensor is installed. Once the purity-height profiles are available the calculation of supersaturation can be done fairly easily. However the development of a control system based on this principal is rather more difficult, primarily due to the number of sensors required.
Inhomogenieties in the massecuite require that at least three temperature sensors are installed in the pan. The most convenient location for the probes has been found to be in the downtake, where it is assumed that the molasses has its highest supersaturation. An absolute pressure sensor is necessary, not only to control the pressure in the pan, but also to enable the equivalent boiling temperature of water to be calculated. Since the molasses purity profile is required, a level sensor also has to be installed to continuously measure the massecuite height.

The control system associated with these sensors has to be capable of performing routine mathematical operations, such as multiplication, division, logarithms etc in order to calculate the supersaturation from the available data.The overall complexity of the control system utilising supersaturation may pose too many problems for most factory installations and hence may not be the most cost effective method for pan automation.

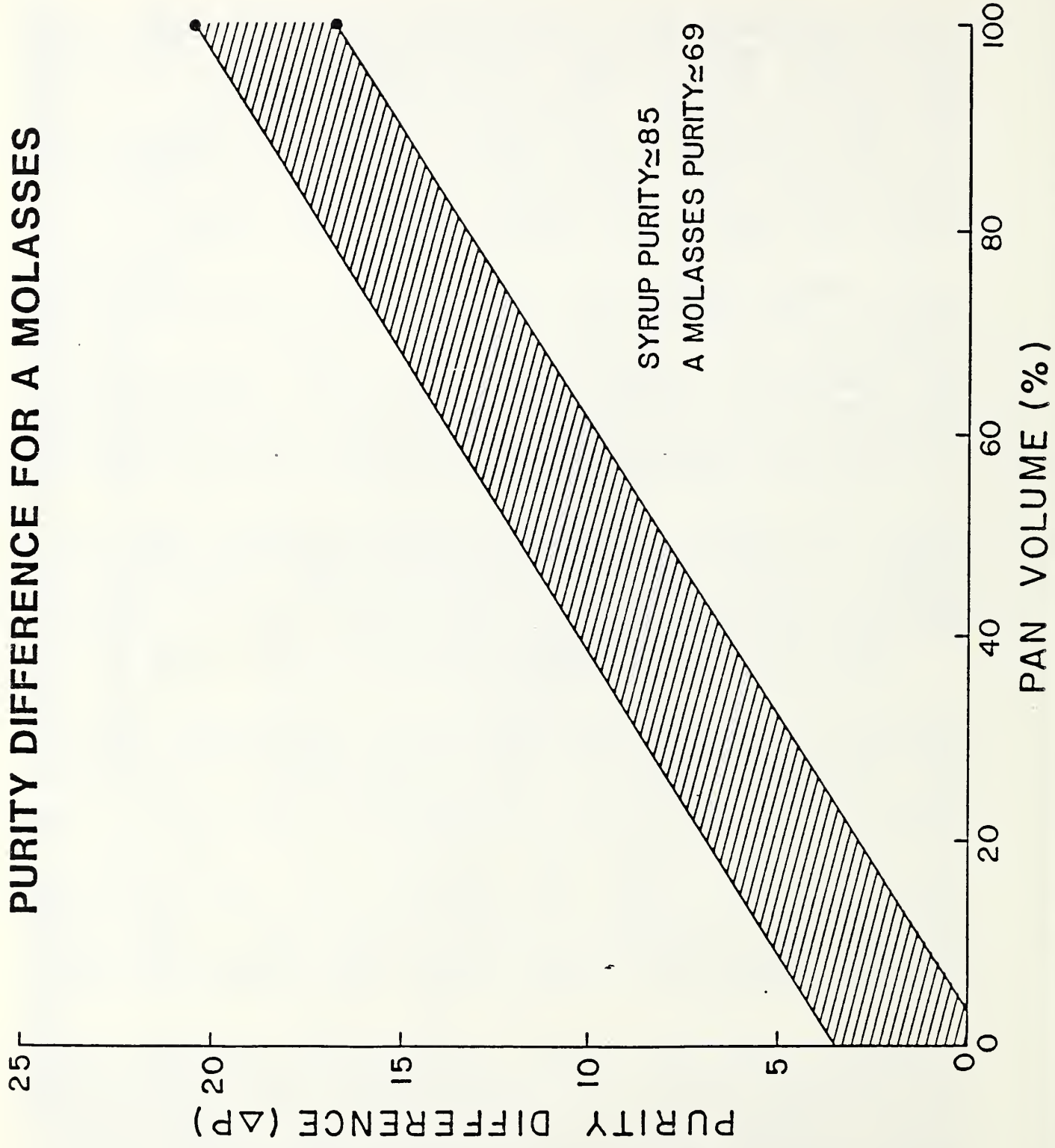
Apart from the complexity of installation and implementation of a supersaturation system, one of the major problems is associated with the sensitivity of the sensors used. Figure 4 illustrates the variations of supersaturation with pressure, temperature and purity. Since supersaturation has to be calculated to an accuracy of about 0.02 the corresponding sensitivities of the measured variables are 0.15" Hg in pressure, 2.0 points in purity and 0.8 F in temperature. The accuracy with which the pressure and temperature have to be measured is close to the limit of the sensors and hence errors may be introduced if there is significant sensor drift. The use of "smart transmitters" for temperature probes can overcome some of the inherent error but these units are expensive and may not be of significant benefit.

The accuracy with which the purity has to be known is within the limits of the profiles shown earlier and hence provide a sufficiently good representation of changes in the pan. Comparison of manual and automatic control via supersaturation is shown in table 1, where for a set of low grade strikes it can be seen that there is a reduction in purity of the cyclone molasses of about 2.5 points. In these strikes not only was the purity changed as indicated by the theoretical profiles but also the supersaturation set-point was also increased during the strike to attempt to keep the crystyal growth rate as high as possible.



DIFFERENCE IN PURITY AS A FUNCTION OF VOLUME IN PAN

FIGURE 2.


PURITY DIFFERENCE FOR A MOLASSES
SYRUP PURITY≃85
A MOLASSES PURITY≃69
PURITY DIFFERENCE (ΔP)
PAN VOLUME (%)
0
5
10
15
20
25
0
20
40
60
80
100

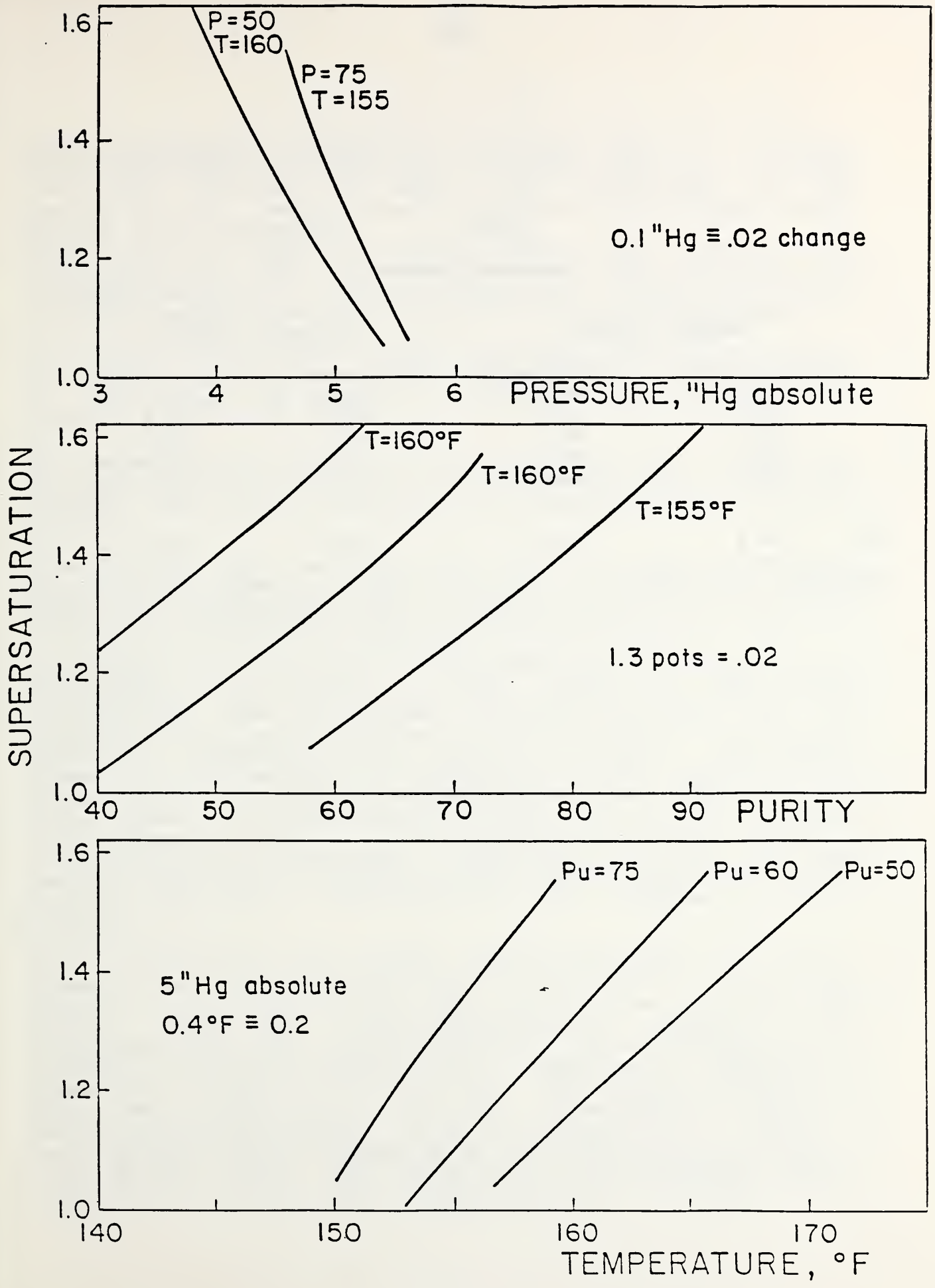

P=50
T=160
P=75
T=155
0.1 "Hg ≡ .02 change
PRESSURE, "Hg absolute
SUPERSATURATION
T=160°F
T=160°F
T=155°F
1.3 pots = .02
PURITY
Pu=75
Pu=60
Pu=50
5" Hg absolute
0.4°F ≡ 0.2
TEMPERATURE, °F

FIGURE 4.

TABLE 1.

Low Grade Strikes.

	MANUAL CONTROL		AUTOMATIC CONTROL	
	Mass purity	Mol purity	Mass purity	Mol purity
	59.0	43.7	59.2	42.1
	58.4	43.2	58.6	41.4
	57.9	43.7	58.4	43.2
	58.6	44.6	57.7	40.8
	58.0	44.0	58.4	41.2
Avg	58.4	43.8	58.4	41.3
Avg C.C.	25.9		29.3	

Radio frequency conductivity, unlike its low frequency counterpart, does not rely on an electrode which is in contact with the massecuite. The sensor probe is insulated from the massecuite by a teflon shield and acts like a radio antenna placed in the massecuite.
Since there is only a single sensor, the installation is relatively simple and the control system is easy to operate. Two different methods of using the conductivity signal are possible, depending on the type of strike and the operators preferences.

a) Constant conductivity:- under these conditions the conductivity set point is kept constant until the strike level is reached, and at this time the strike is tightened by increasing the conductivity to some preset value.

b) Ramped conductivity:- the set point for the conductivity controller is increased with time from the beginning to the end, in such a way that no tightening up is necessary at the end of the strike.

The studies from the last crop show that the conductivity profiles are linear with time, unlike the purity profiles which were linear with height. This simplifies the use of conductivity control by eliminating the need for a level sensor.

One of the major difficulties with conductivity control has been the effects of changes in magma purity on the initial conductivity when the footing is pulled into the pan. This however does not seem to be particularily important since initial values of conductivity do not vary by more than a few percent. Other difficulties due to fluctuations in ash content of the liquor also do not seem to be important and hence the initial and final values for conductivity of a particular strike during the crop appear to remain fairly constant. Figure 5 shows two A strikes boiled with different conductivity profiles, one ramped and the other with a constant value. Similar results have also been obtained for B strikes and a typical profile is shown in figure 6.

Data obtained from A and Top-off strikes during the last crop are shown in table 2, where the local control is via a consistency sensor. The molasses purity for the A strike is about three points lower with conductivity control compared to the consistency controlled strikes. Although the massecuite purity is somewhat lower with conductivity, a reduction in purity of at least two points is obtained. For the Top-off strikes the reduction in purity is not as great, corresponding to about 1.5 points only. Unfortunately due to the availability of sensors it was not possible to operate more than one pan at a time on conductivity control and hence overall boiling house control could not be accomplished to determine the total effect of pan control.

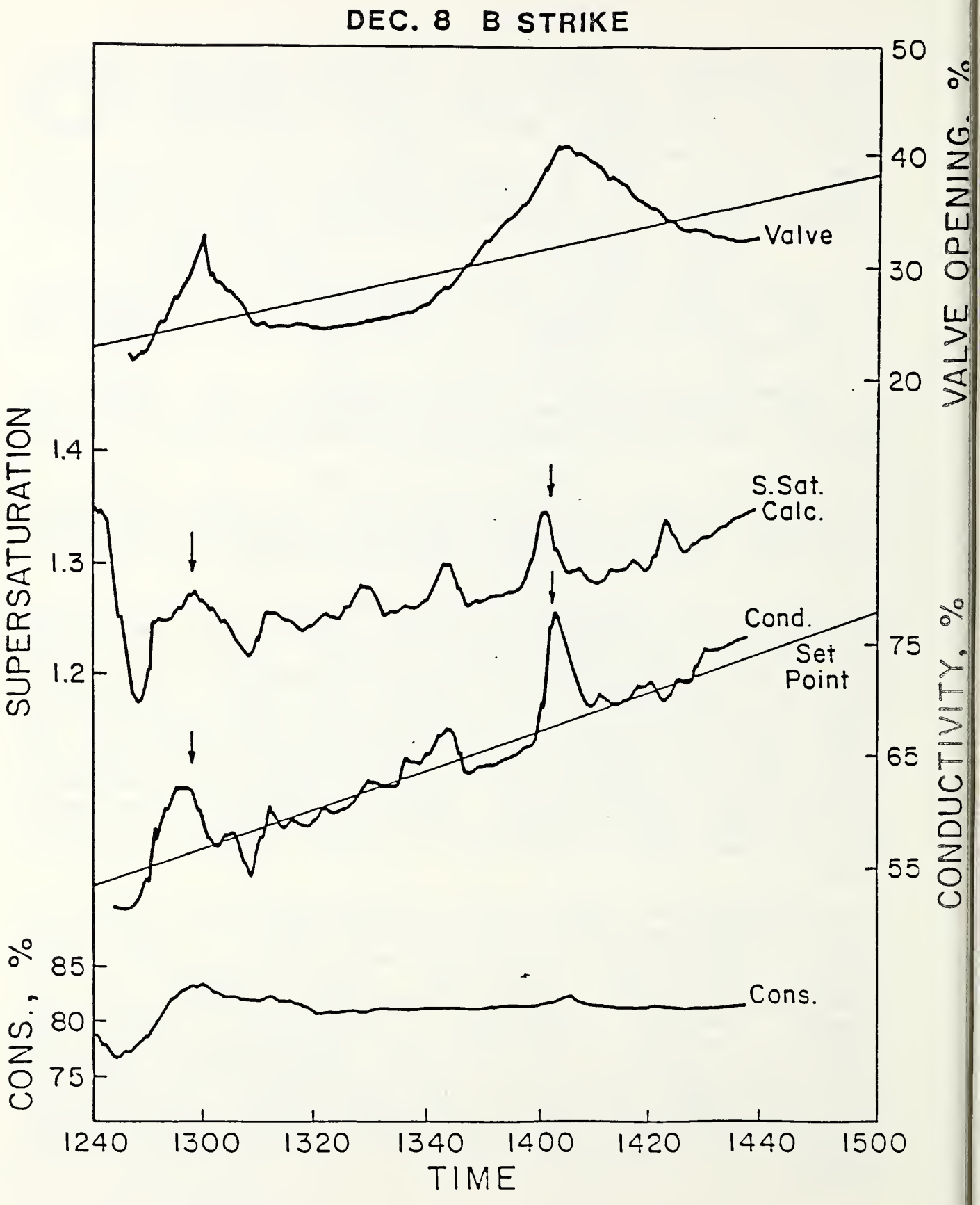

DEC. 8 B STRIKE
VALVE OPENING, %
50
40
30
20
Valve
SUPERSATURATION
1.4
1.3
1.2
S.Sat.
Calc.
Cond.
Set
Point
CONDUCTIVITY, %
75
65
55
CONS., %
85
80
75
Cons.
1240
1300
1320
1340
1400
1420
1440
1500
TIME

FIGURE 6.

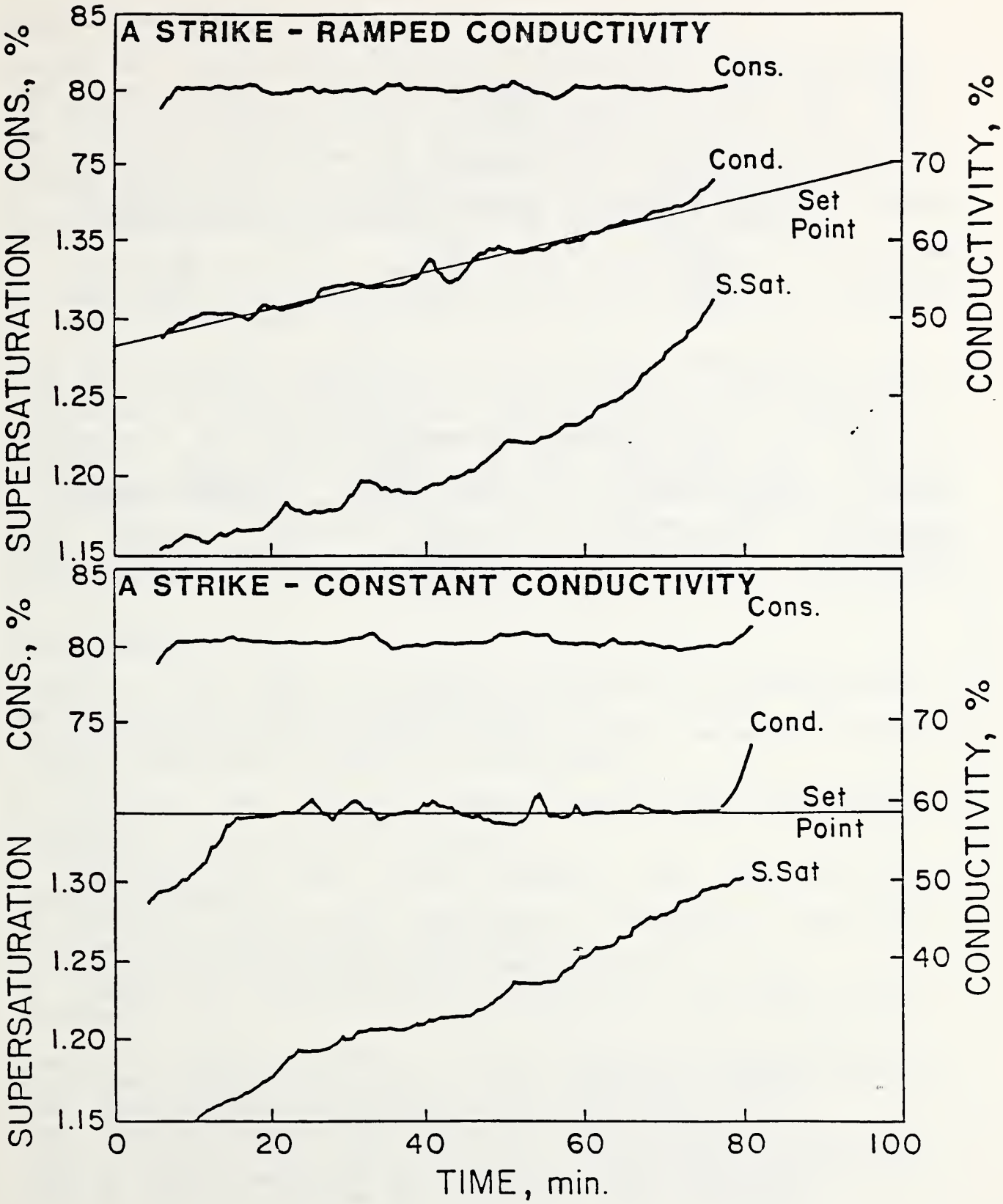

A STRIKE - RAMPED CONDUCTIVITY
Cons.
Cond.
Set Point
S.Sat.
A STRIKE - CONSTANT CONDUCTIVITY
Cons.
Cond.
Set Point
S.Sat
CONS., % SUPERSATURATION
CONDUCTIVITY, %
85
80
75
1.35
1.30
1.25
1.20
1.15
70
60
50
40
0
20
40
60
80
100
TIME, min.

FIGURE 5.

TABLE 2.

A STRIKE

Sample	Local control	S.Satn control	Condty control
Mass Pu	86.8	86.3	85.8
Mol Pu	69.3	68.2	66.2
Crystal %	57.0	56.8	58.0

A TOP-OFF STRIKE

Sample	Local control	S.Satn control	Condty control
Mass Pu	82.1	81.9	81.3
Mol Pu	61.7	61.9	59.1
Crystal %	53.3	52.5	54.3

Control Analysis

During the analysis of the control methods, it became apparent that fixed constant controllers would not provide the full range of control required to ensure optimum operation of the pans. When using P.I.D. control, it is normally assumed that the system is in equilibrium and that the time constants of the system do not change. While this is normally true for a continuous process, it is rarely valid for a batch process such as pan boiling. The major effects on response time in the system are caused by:-

a) changes in hydrostatic head across the feed control valve.
b) reduction in the heat transfer coefficient as the pan fills.
c) massecuite response time.

The heat transfer coefficients, and thus the evaporation rate, vary by a factor of about 5:1 from the start to the end of the strike and the hydrostatic head causes the feed valve opening to change by a factor of about 2, for a constant flow. In order to overcome these difficulties. it is necessary to use an "ADAPTIVE CONTROLLER", which will sample the operation of the process and modify the values of the P, I, and D components of the loop to compensate for process changes. This technique allows the loop to be tuned correctly throughout the strike and hence optimises the control function.

Design Layout.

Figures 7 and 8 show the schematic diagrams for supersaturation and conductivity control respectively.
If supersaturation is used as the controlling variable, then the control system has to perform the following:-

a) calculate the boiling point of water from the absolute pressure.
b) average the temperature readings.
c) calculate the liquor purity based on the feed purity and massecuite level.
d) calculate boiling point elevation of the mother liqour from the purity and massecuite temperature.
e) calculate supersaturation from the above data.
f) change the supersaturation set point as the liquor purity decreases.

The implementation of this control process can be complicated and expensive, particularily due to the number of sensors required and hence may not be best method for local conditions.
The implementation of conductivity control relies on a single sensor together with a ramp generator and an adaptive controller. This is simpler and much less expensive than for supersaturation control and appears to be more suited to local conditions.

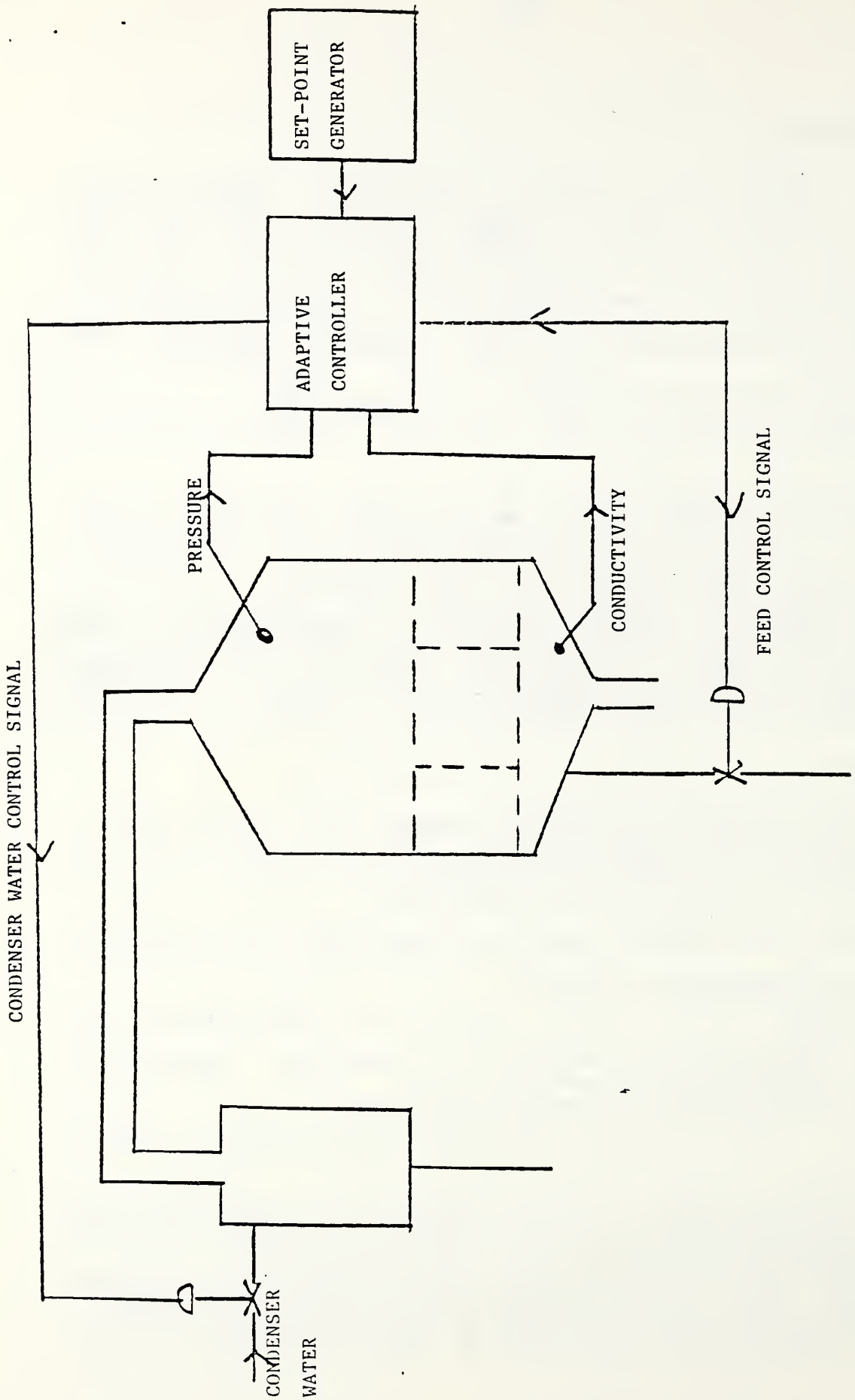

SET-POINT GENERATOR
ADAPTIVE CONTROLLER
PRESSURE
CONDUCTIVITY
FEED CONTROL SIGNAL
CONDENSER WATER CONTROL SIGNAL
FEED LINE
CONDENSER WATER

FIGURE 8.

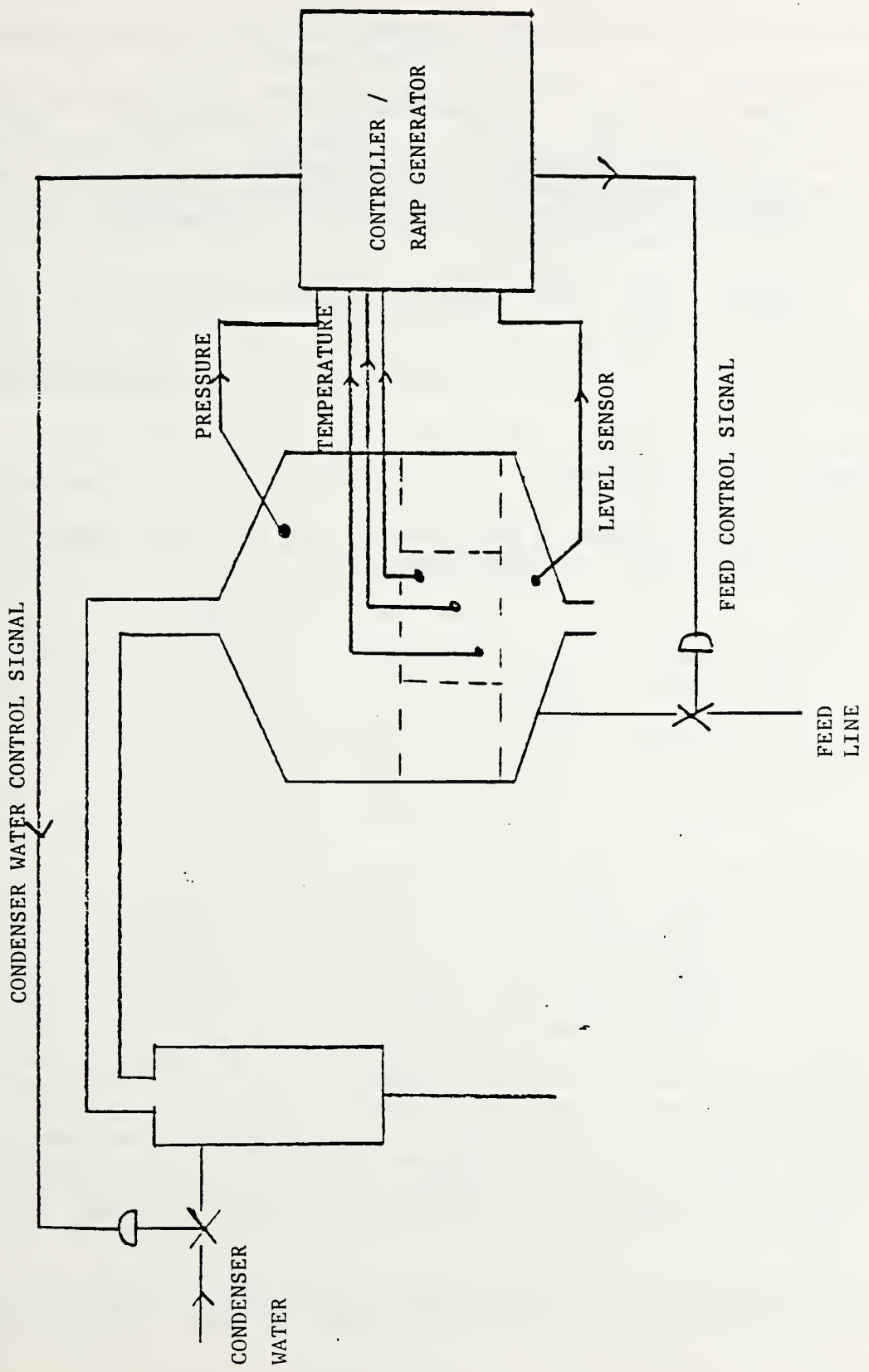

CONTROLLER /
RAMP GENERATOR
PRESSURE
TEMPERATURE
LEVEL SENSOR
CONDENSER WATER CONTROL SIGNAL
FEED CONTROL SIGNAL
CONDENSER
WATER
FEED
LINE

FIGURE 7.

Comments.

Both superaturation and radio frequency have ben used as the control variables for vacuum pan automation. While supersaturation provides direct information concerning the properties of the mother liquor in the pan, it is a complex and expensive method to install. Conductivity on the other hand is simpler to install and use, but it does not provide direct information about the masseciute.
Conductivity profiles do not appear to vary significantly with external parameters and the available data suggest that the profiles can be kept fairly constant during the crop. Different installations may differ in absolute value for conductivity, but it is expected that the relative changes should remain very much the same.

Acknowledgement.

This work was supported with a grant from The American Sugar Cane League to whom the author is deeply grateful.

OPTIMIZATION OF THE PERFORMANCE OF LOW-GRADE CRYSTALLIZERS IN THE SUGARCANE INDUSTRY

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INTRODUCTION

The introduction in the sugar industry of new types of crystallizers, most notably those of vertical design with high-efficiency cooling systems[1,2,3,4,5,6] represents a new challenge to develop guidelines for their most efficient use. Among their advantages are[1] : (a) small floor space requirements and a possibility of outdoor installation, (b) high efficiency of cooling, (c) ease of automatic control, (d) good flow patterns with little or no dead volume and short-circuiting, (e) capability to handle high-viscosity magmas and (f) low cost. As to the practice of low-grade cooling, in the words of Culp[7] "many "rules of thumb" have been published by our better known technologists with very little scientific work done up to date". In particular, questions remain concerning the optimum magma composition at the crystallizer inlet, in terms of Brix and purity (i.e. two variables that can easily be manipulated in the vacuum pans), the rate of cooling in the crystallizers, final temperature of the magma, etc.

The rate of cooling especially has been a subject of frequent and contradictory statements. Thus Payne[9] recommends cooling as rapid as physically possible quoting experience with cooling at 3 C/hr in a crystallizer with 1 m^2/m^3 heat transfer area that did not present any danger of nucleation. This was supported by Foster[9] and others but contradicted recently[1] by Hugot arguing for cooling not faster than 1 C/hr with an initial period of 1 to 2 hours of no water cooling at all. Despite the well known differences in composition, it is interesting to note the recommendations of sugarbeet technologists. Thus Wagnerowski[10] on theoretical grounds and Nielsen[2] from practical experience on full scale equipment recommend initial rapid cooling (5 and 3 C/hr respectively) followed by cooling at an exponentially declining rate[10]. Pilot-plant trials at DDS[2] showed that no nucleation ocurred even at a rate of 10 C/hr.

It has been recognized for some time that the basis for optimizing the process must be the knowledge of the kinetics of sucrose

crystallization at the conditions of low purity. It is well documented that for sucrose because of its high solubility and high viscosity of its aqueous solutions, the crystallization rate first increases with rising supersaturation, then reaches a maximum and declines at even higher levels of supersaturations. While in high-purity sucrose solutions the values of supersaturations corresponding to the maxima are unattainable since nucleation sets in long before, at high impurity levels the maxima in R occur at moderate values of σ and are of practical importance in the industry. The concept of optimum cooling, where the temperature T(t) is a locus of the maxima of a series of R(T) curves of descending C_s values has been frequently invoked in the literature[11,12,13,14] but its full implementation has been hindered by lack of reliable kinetics data that would cover the full range of conditions encountered. This is a prerequisite since any extrapolation of the data beyond the experimental range is questionable due to the highly non-linear character of the solution viscosity and growth rate kinetics functions.

We have recently[15] measured the crystallization rate of sucrose from impure sugarcane solutions up to the C_{imp} values of 4.8 and a growth rate equation (Figure 1)

$$R(\mu/min) = 52.7\ v^{-(4.74/Cimp)}\ \sigma \qquad (1)$$

was found to fit adequately the data as well as our previous measurements[16] done at medium purities (C_{imp} from 2 to 3). Considering the sparsity of published data, equation 1 is believed to be the most reliable and also sufficiently accurate and general to cover the whole range of purities encountered in the low-grade sugarcane crystallization.

In this communication we want to illustrate the use of the crystallization kinetics data in modelling the performance of low-grade crystallizers as well as in determination of process parameters that lead to maximum molasses exhaustion. We will first review the concept of optimum cooling and the use of mass balance to describe the crystallizer operation. The equation 1 is then used to solve numerically the appropriate set of equations, subject to realistic limitations, that describe the system. The results are used to identify the operational parameters that maximize the crystallizer performance as well as to comment on some design aspects of the crystallizers. The manipulable parameters that are investigated are the magma Brix and purity, and its crystal content. While the Brix value can easily be manipulated in the vacuum pan, its purity has to be considered in conjunction with the overall boiling scheme. Even though the data used, i.e. the crystallization kinetics equation, solubility and viscosity were either derived or at least verified in Louisiana conditions, it is believed that the conclusions are of general nature.

MATHEMATICAL DESCRIPTION OF THE CRYSTALLIZERS. OPTIMUM COOLING.

The mass balance on sucrose in a batch crystallizer with feed and solvent removal (water evaporation or dilution) leads to a first-order non-linear differential equation

$$(d/dt)\ [\ m_w(C_s + W)] = f\ X_w'\ C_s' \qquad (2)$$

that can be solved numerically for a given set of initial conditions and a set of complementary equations describing the system and its physical properties:

$$m_w = m_{wo} + (f\ X_w' - e)\ t \qquad (3)$$

$$dW/dt = g + n = 6 \alpha N \rho L^2\ R + n \qquad (4)$$

$$R = F_1(\ \sigma\ ,\ T,\ C_{imp},\ \ldots) \qquad (5)$$

$$\sigma = (C_s\ /\ C_{seq}) - 1 \qquad (6)$$

$$C_{seq} = -SC\ /\ (1 - 1/X^{oseq}) \qquad (7)$$

$$SC = F_2(\ C_{imp},\ C_{RS}/C_{ash},\ \ldots) \qquad (8)$$

$$v = F_3(T,\ X_{TDS},\ C_{imp},\ \ldots) \qquad (9)$$

$$V = F_4(v,\ cc,\ \ldots\ ) \qquad (10)$$

$$T = F_5(t) \qquad (11)$$

The design of the modern crystallizers minimizes the deviations from an ideal plug-flow[2,5] so that the previous equations are equally valid for continuously operated crystallizers (at steady-state) with x(A/F) substituted for time, t. The solution gives the sucrose concentration, purity, supersaturation, etc. at all times including the end of crystallization. The OPTIMUM COOLING is defined as a temperature profile T(t) for which the temperature at all times is such that the growth rate is always at its maximum (for example, at the composition in Figure 1, this temperature is 54 C). If optimum cooling is to be determined, an additional equation

$$dR/dT = 0 \qquad (i)$$

arises that is used instead of equation 11. Because the growth rate R(T) is a function without a minimum (Figure 1), at least within a reasonable range of temperatures, the usual second derivative condition is not necessary here for defining a maximum. Further constraints have to be imposed on the solution of equation 2 to account for the restrictions of the crystallizers, most notably the cooling rates that are achievable and, at the same time, do not

lead to spontaneous nucleation and the maximum massecuite viscosity that can still be accomodated in the process; either in the crystallizers, pumps or centrifugals,

$$- dT/dt < CR_{max} \qquad (ii)$$

and

$$V < V_{max} \qquad (iii)$$

Even though these limits are specific for each installations, the constraints in Table I are believed to be realistic for the equipment prevailing in the industry.

SOLUTION

The set of equations 2 through iii was solved numerically with the explicit Euler-type integration where the solution $C_s(t_i+h)$ at time t_i+h is approximated as

$$C_s(t_i+h) = C_s(t_i) + h\ (dC_s/dt) \qquad (12)$$

and where the differential dC_s/dt, given by equation 2, is evaluated at time t_i. The accuracy and stability of the solution require a small time step h, proportional to 1/R. A time-variable step

$$h\ R = 0.05 \text{ micrometers} \qquad (13)$$

was found to give a stable solution of sufficient accuracy while minimizing the computation requirements. At each time step the temperature is calculated iteratively such as to satisfy equation i (where the differential is calculated from equation 5) unless one or both of the other limits are violated. If so, the temperature is calculated so as to just satisfy the most restrictive condition, i.e.

$$T(t_i+h) = T(t_i) - h\ CR_{max} \qquad (14)$$

or

$$V(T(t_i+h)) = V_{max} \qquad (15)$$

RESULTS AND DISCUSSION

Three regions that correspond to the three constraints i, ii and iii are distinguishable on the calculated (constrained) optimum cooling curves (COC) in Figure 2. First, the cooling is carried out at the maximum rate (3 C/hr) for a length of time that depends on the magma composition. Then, a period of time exists when the growth rate is at its maximum (condition i) followed by a period of nearly constant temperature when the magma has reached its limiting viscosity (condition iii). Here and in the following it is assumed that crystallization starts at a temperature that gives maximum R at the given (initial) composition. This is to avoid either undersaturation or too high supersaturation at some combinations of X_{TDSo} and $(C_s/C_{TDS})_o$ that would occur if the initial temperature was taken constant, e.g. 70 C. All other parameters used in these and consequent runs are listed in Table I. In figures 3 through 8 the results of 400 runs are summarized where the initial parameters, X_{TDSo} and $(C_s/C_{TDS})_o$ (total dissolved solids and purity), of the mother liquor at the START OF COOLING CRYSTALLIZATION are plotted on the horizontal axes and a parameter of the mother liquor or magma (purity, temperature, viscosity, .. etc.) AT THE END OF COOLING on the vertical axis. Naturally, of immediate importance is the plot of final molasses purities (Figure 3). Here, we are looking for such composition of the initial magma that will give us, for a given type of molasses and a given crystallizer station described by the parameters of Table I, a MINIMUM PURITY of the final molasses. The minimum of $(C_s/C_{TDS})_o$ of around 0.37 occurs at X_{TDSo} of 0.855 and is only slightly dependent on the purity of the initial magma. This, of course, is a consequence of the retention time in, or capacity of, the crystallizers which is sufficient for the magma to nearly reach equilibrium over a large range of the initial parameters (Figure 4).

The minimum (Figure 3) of molasses purity lies between the regions of viscosity control at $X_{TDSo} > 0.86$ and a region at $X_{TDSo} < 0.84$ where the exhaustion is limited by the rate of crystallization of sucrose. At the crystal content of 35.6 %, used in these calculations, X_{TDSo} of 0.855 corresponds to the TDS content of the magma of 90.7 % or refractometric Brix of about 94.0 %. Any deviation from the optimum Brix will lead to an increase in the purity of the final molasses. The slopes of the final molasses surface (Figure 3) that are nearly constant at $X_{TDSo} > 0.875$ and $X^{TDSo} < 0.855$ indicate that for each point **increase** in the Brix value of the initial mother-liquor (or about 0.6 points of the magma Brix) the final molasses purity will increase by about 1 point. For each point **below optimum** the final molasses rise will be almost twice as much (1.8).

The approach to equilibrium is documented in Figure 4. The difference between the actual molasses purity and the equilibrium one (at the same C^{imp} and T^f, the end-temperature) is plotted on the vertical axis. The equilibrium is reached in the viscosity-

controlled zone where the end-temperature T^f is high (Figure 5). At the optimum value of X^{TDSo} of 0.855, the excess purity of about 0.3 corresponds to an undercooling of only about 1 degree C and any re-heating before the centrifugals is therefore likely to result in undersaturation. The losses though may be reduced by keeping the re-heating period short[9].

The END-TEMPERATURE is a crucial parameter in molasses exhaustion and is , as expected , an increasing function of the massecuite Brix (Figure 5). With the crystal content of 35.6 %, the values of X_{TDSo} of 0.82, 0.84, 0.86, 0.88 , 0.90 and 0.92 correspond respectively to the approximate refractometric Brix values of the magma of about 91.4, 92.8, 94.2, 95.6, 96.9 and 98.2. The minimum purity that was found from Figure 3 to lie at X_{TDSo} of 0.855 or the magma Brix of around 94.0 % irregardless of the initial purity, corresponds to the end-temperatures between 28 and 33 C with the lower values required for magmas of higher initial purities. This range of end-temperatures is considerably lower than the temperatures encountered in the industry that rarely go below 40 C. Thus this is in qualitative agreement with observations that better exhaustion correlates with lower end-temperatures[17]. Occasional objections from the industry against lowering the temperature below 40 C and a frequent need in the crystallizers to dilute the magmas is an indication that the Brix of the industrial magmas is frequently **above** the optimum level. The overall purity drop in the crystallizers and the final magma viscosity are plotted in Figures 6 and 7 respectively. We see that at the optimum level of X_{TDSo} of 0.855, the crystallization is carried out such that the viscosity limit just becomes active at the end of crystallization. This is also obvious from Figure 2. The viscosity of the mother-liquor (final molasses) compensates for the increased final crystal content and is about half (200 Pa.s) at the initial $(C_s/C_{TDS})_o$ of 0.5 as compared with $(C_s/C_{TDS})_o$ of 0.4 (Figure 8). The overall purity drop that increases almost linearly with $(Cs/C_{TDS})_o$ would be expected to level off at even higher purities when the crystallizer capacity would become insufficient to handle the load.

The effect of CRYSTALLIZER CAPACITY is analyzed in Figures 9, 10, 11 and 12. Here, the parameters from Table I were used with the exception of the retention time, that was varied between 10 and 50 hours. The final molasses purity differences are plotted for retention times 10, 20 30 and 40 hours while the 50 hour purity is taken as the basis value. It should be noted that the purity loss from insufficient crystallizer capacity is HIGHEST at the optimum magma composition, X_{TDSo} of 0.855 or the magma Brix of 94.0 %. This, of course is a consequence of the fact that the utilization of the crystallizer and the purity drop (Figure 6) are highest and that measurable exhaustion/crystallization proceeds for the longest time. For very heavy magmas, at the high X_{TDSo} end, the (constrained) optimum end-temperature is high (Figure 5) and crystallization (and cooling) is complete within a few hours. Any expansion of the crystallizers under these circumstances will not contribute to increasing exhaustion. Even though a complete analysis must include

economic aspects of the sugar production as well as the capital and operating costs of the crystallizers, it appears that little can be gained from retention times longer than 50 hours.

The CRYSTAL CONTENT of the magma, that can be manipulated by e.g. pre-centrifugation, effects both the magma viscosity (and, when its limiting value is fixed as in equation iii) the maximum value of X_{TDSo}) as well as the overall mass crystal growth rate. One would intuitively expect that any gain that may be derived at working at lower initial crystal content and therefore at higher X_{TDSo} can only be realized when the capacity of the crystallizers is sufficient. When the purity of final molasses is plotted against the initial crystal content at such X_{TDSo} values at which it is at its minimum, the lowest values are found at crystal contents between 35 and 45 %, with the lower values for larger capacity crystallizers. The plot in Figure 13 corresponds to cross-sections of the surface from Figure 3 at $(C_s/C_{TDS})o = 0.5$ (parallel to the X_{TDSo} axis) at various crystal contents and retention times.

SUMMARY

Constrained optimum cooling (COC) was defined as the optimum cooling limited by the cooling rate and magma viscosity that can be achieved and handled in the process. Although these must be evaluated for each specific installation, values believed to be representative were used to calculate the COC profiles for a wide range of magma parameters. It was found that at the initial mother-liquor total solids content of 85.5 that corresponds to a magma Brix of around 94.0, the final molasses purity is at its minimum. Any deviation from the optimum magma Brix will result in a significant increase of the final molasses purity. It is estimated that for each 0.6 % magma Brix above and below the optimum level, the final molasses purity will rise by about 1.0 and 1.8 points respectively.

The final COC temperature, for optimum magma parameters, is around 30 C, i.e. significantly lower than the actual industrial practice. This supports the industrial observations that lower end-temperatures correlate with lower final molasses purities but also, because of frequent problems in the industry with excessive magma viscosities, emphasizes the need for identifying and adhering to the optimum magma parameters.

It is believed that the approach outlined in this communication can serve as a basis for a rational operation and control of the modern crystallizers. Complications stemming from fluctuations in content of dextran and possibly other polysaccharides that could cause large deviations of the actual viscosities from the calculated ones can be easily handled with in-situ continuous viscosity monitors. A feed-forward type of control employing the present model can be used to deal with the slow response characteristics of the large scale crystallizers.

NOTE

All the computer programs developed in the course of this work, that determine the constrained optimum cooling regime and simulate the crystallizer operation for a given, imposed cooling profile (equation 11) or the calculated optimum cooling are available from the author in either BASIC or FORTRAN versions for IBM-compatible mainframe or personal computers.

ACKNOWLEDGMENTS

The continuous support of the American Sugar Cane League is gratefully acknowledged.

NOMENCLATURE

A	- free crystallizer cross-section; m^2
C	- concentration; kg/kg water
cc	- crystal content; kg/100 kg magma
cr	- crystal content; m^3 crystal/m^3 mother-liquor
CR	- cooling rate; C/s
e	- evaporation rate; kg/s
f	- feed rate; kg/s
F	- volumetric flow of magma; m^3/s
g	- mass crystal growth rate; kg/kg water s
h	- integration time step; s
L	- characteristic length of the crystal; m
m	- mass; kg
n	- nucleation rate; kg/kg water s
N	- number of crystals; 1/kg water
R	- linear crystal growth rate = 0.5(dL/dt); m/s
SC	- solubility coefficient = C_{seq}/C_{seq})
t	- time; s
T	- temperature; C
TDS	- total dissolved solids; kg/100 kg
x	- position in the crystallizer; m
X	- concentration; kg/kg solution
v	- mother-liquor viscosity; Pa.s
V	- magma (suspension) viscosity; Pa.s
W	- crystal content; kg/kg water

Greek characters:

α	- volume factor; = 0.36
σ	- supersaturation = $(C_s/C_{seq}) - 1$
ρ	- crystal density; kg/m^3

Subscripts:

eq	- equilibrium
imp	- impurity
max	- maximum
o	- initial
f	- final
RS	- reducing sugars
s	- sucrose
TDS	- total dissolved solids
w	- water

Superscripts

o	- pure water solution ($C_{imp} = 0$)
'	- related to the feed

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Table I

PARAMETER	VALUE	REFERENCE/COMMENTS
F_1 (eq. 2)	$52.7\ v^{-(4.74/Cimp)}$	15
F_2 (eq. 8)	$0.25 + 0.19\ C_{imp}$	15, for $C_{imp} > 3$
F_3 (eq. 9)	$0.11\ (X_s/X_{TDS})-1.3\ \exp(3.7(X_{TDS}-0.19(T-50))/(113.5 - (100X_{TDS} - 0.19(T-50))$	18
F_4 (eq. 10)	10^E where $E = 1.65\ v\ cr\ L^{0.15}$	18
CR_{max}	3 C/hr	2, 8, 9, 22
V_{max}	2000 Pa.s	19, 20, 21
f, e, n	zero	no feed no evaporation no nucleation
L_o	0.225 mm	
cc_o	35.6 %	
residence time in crystallizers	36 hours	

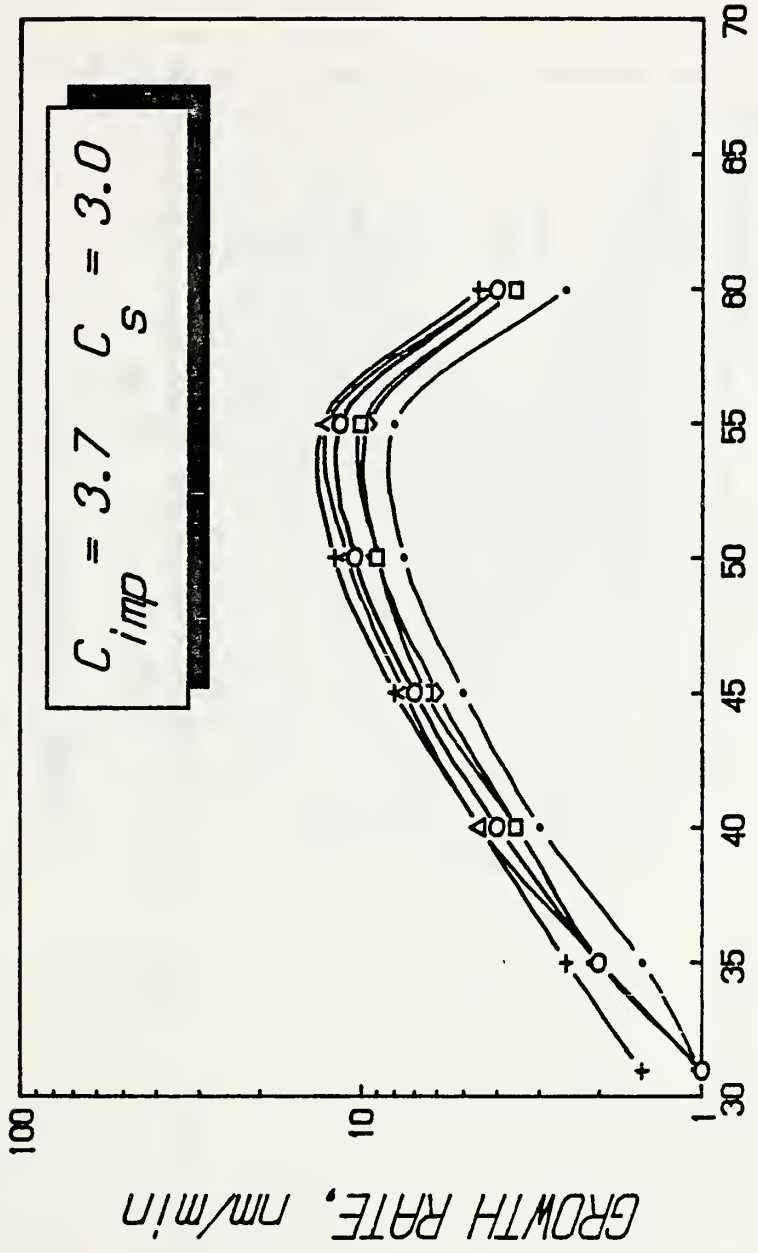

Figure 1: Measured growth rate of sucrose[15] at C_{imp} = 3.7, C_s = 3.0 (purity = 44.8) for nine experimental runs. Saturation temperature app. 61 C.

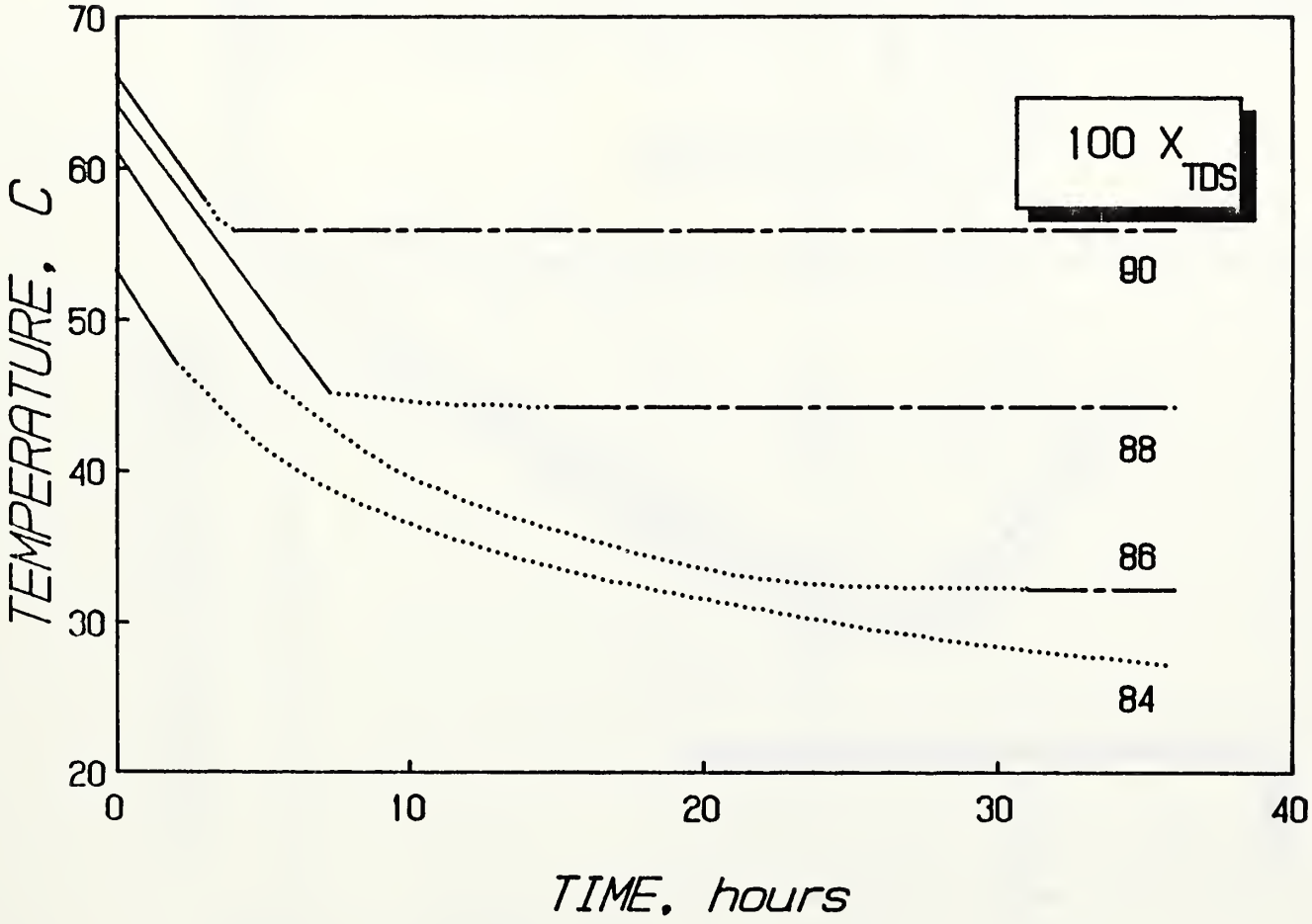

Figure 2: Calculated constrained optimum cooling (COC) profiles for four magmas of X_{TDSo} of 0.84, 0.86, 0.88 and 0.90. (C_s/C_{TDSo} = 0.46. All oter parameters are in Table I. COC cooling calls first for cooling at the maximum rate (cooling rate control region), then cooling is carried out such that the crystal growth rate R is at its maximum (crystallization rate control) followed by nearly constant temperature when the viscosity controls. Full line = cooling rate control, dotted = growth rate control, dashed = viscosity control

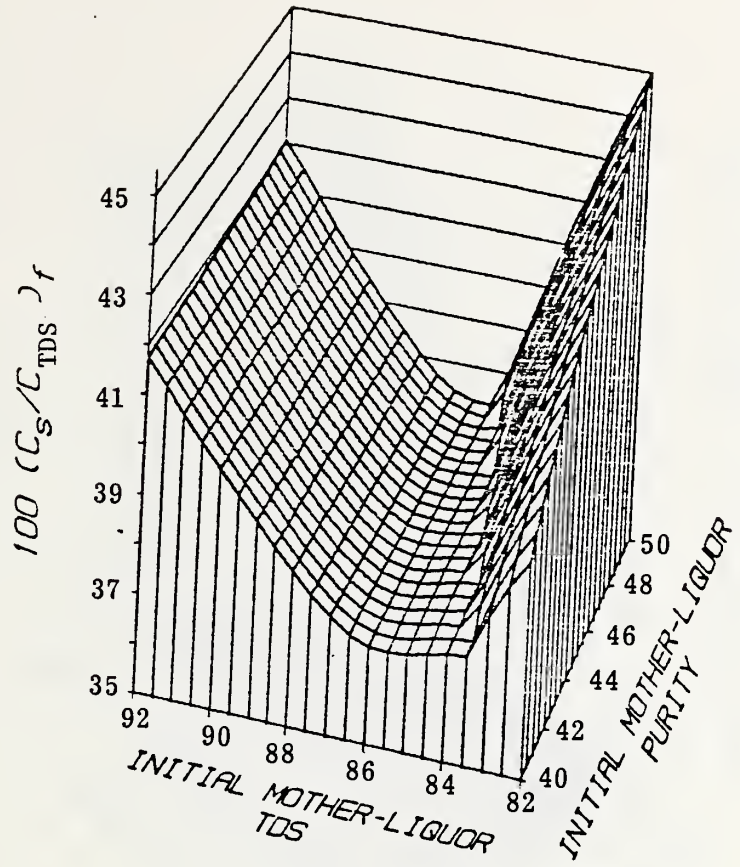

Figure 3: Final molasses purity, COC cooling. Minimum at X_{TDSo} of about 0.855, nearly independent of the initial magma purity. At high X_{TDSo}, viscosity controls, at low X_{TDSo}, crystallization kinetics controls.

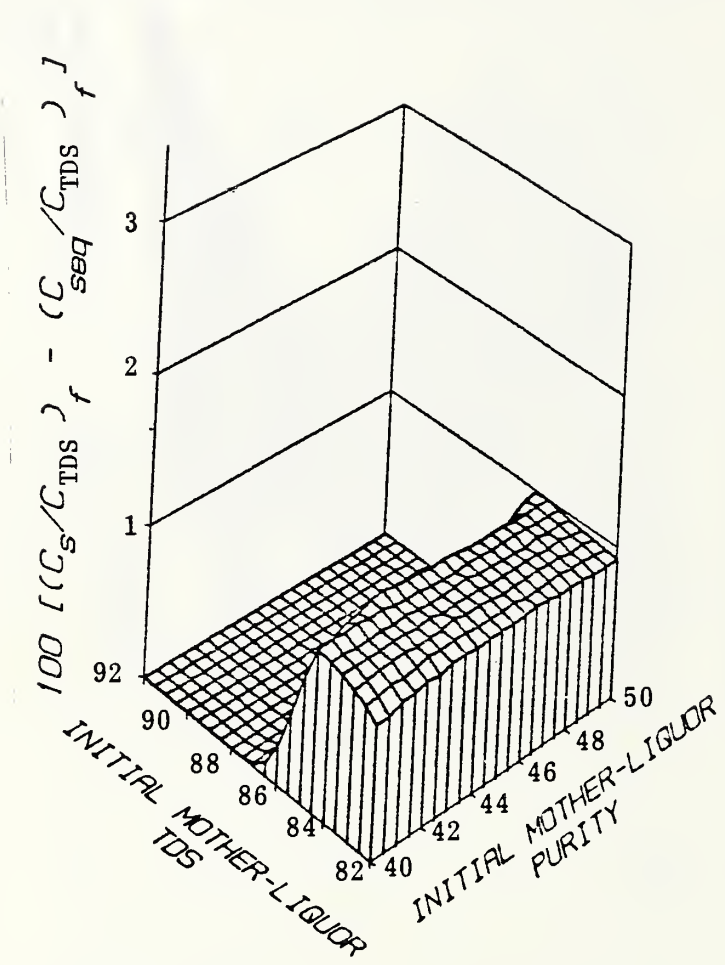

Figure 4: Approach of the final molasses purity to equilibrium under conditions of COC cooling. Equilibrium is reached at high X_{TDSo}, where the viscosity controls. Equilibrium is not reached in the crystallization kinetics regime, at low X_{TSo}.

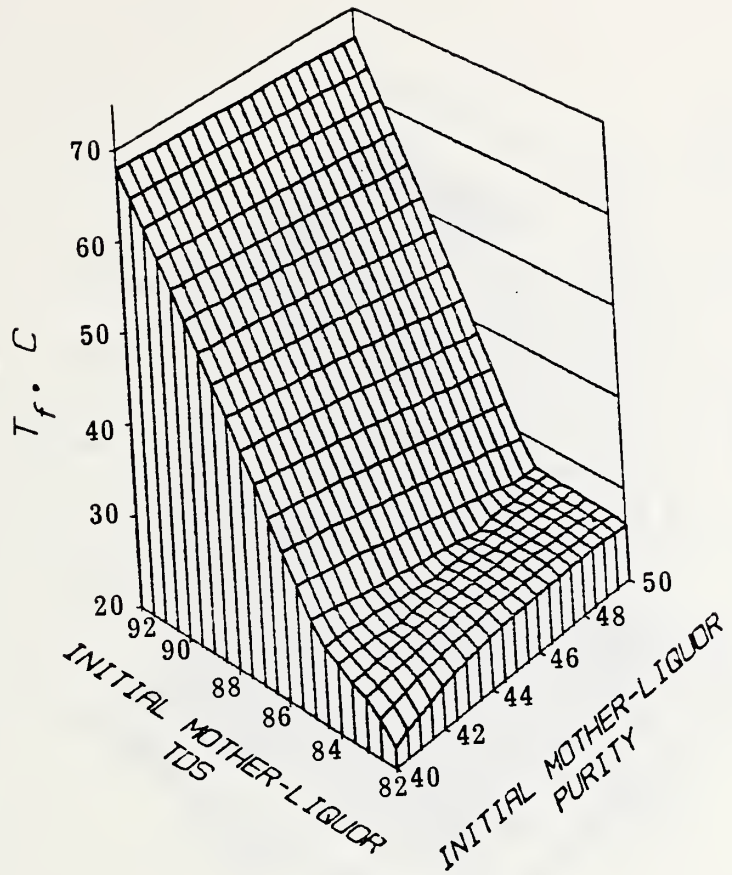

Figure 5: End-temperatures in the crystallizers, COC cooling. Range of 28 to 33 C at the optimum X_{TDSo} of 0.855, depending on the initial magma purity.

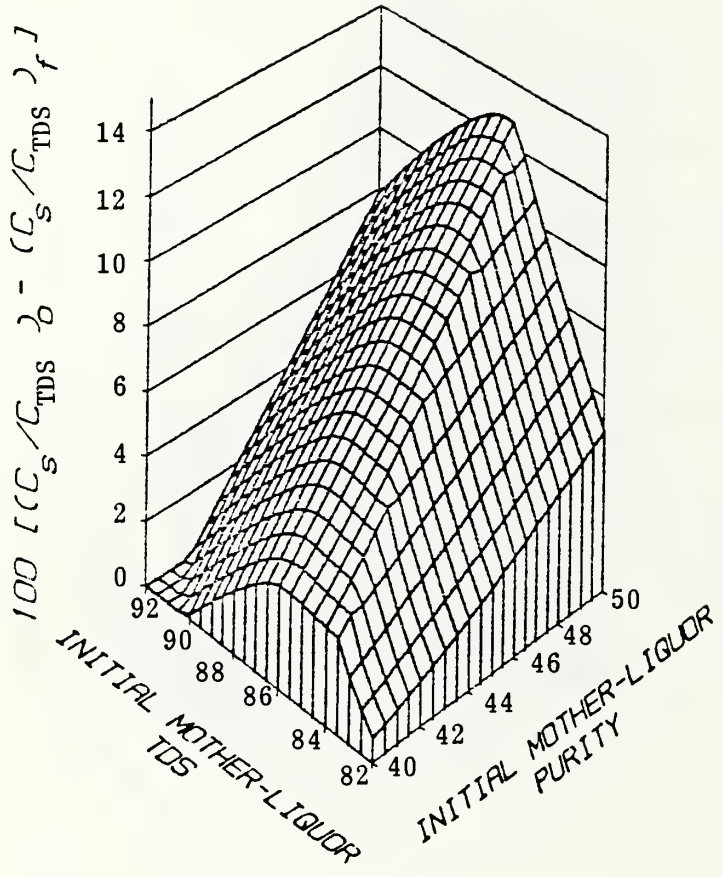

Figure 6: Purity drop in the crystallizers, COC cooling. Maximum occurs, for every initial purity, at the optimum value of X_{TDSo}, 0.855, where the utilization of the crystallizer is highest.

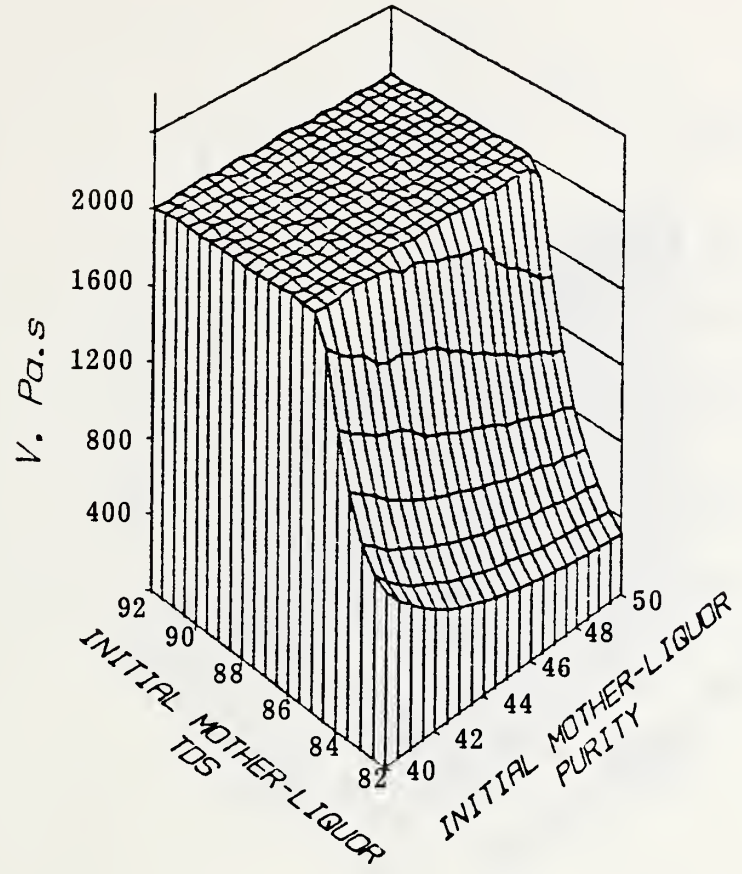

Figure 7: Final magma viscosity. The viscosity constraint becomes just active at the optimum level of X_{TDSo}, 0.855.

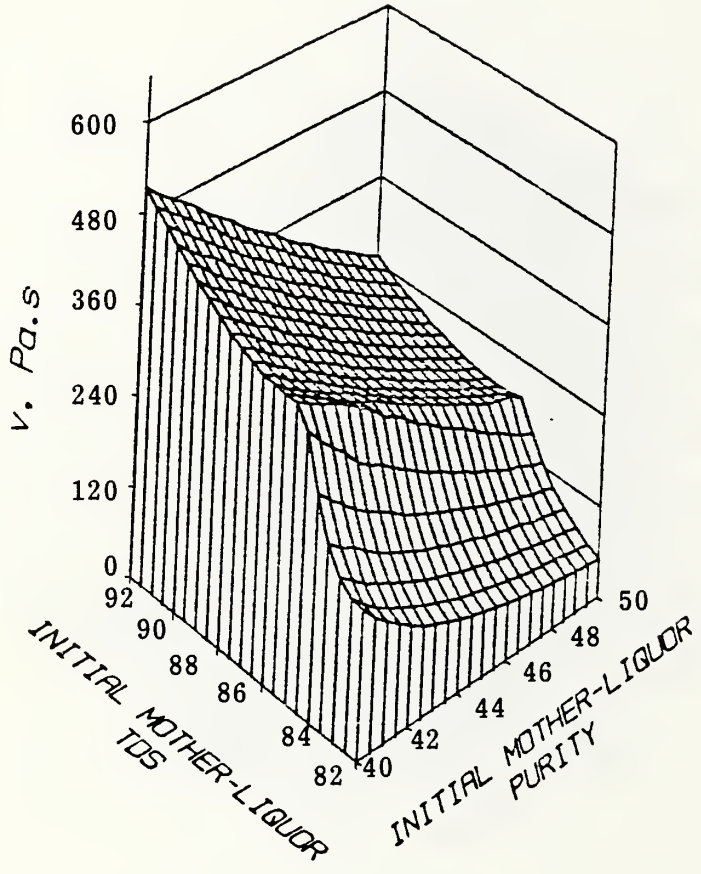

Figure 8: Final molasses viscosity, COC cooling.

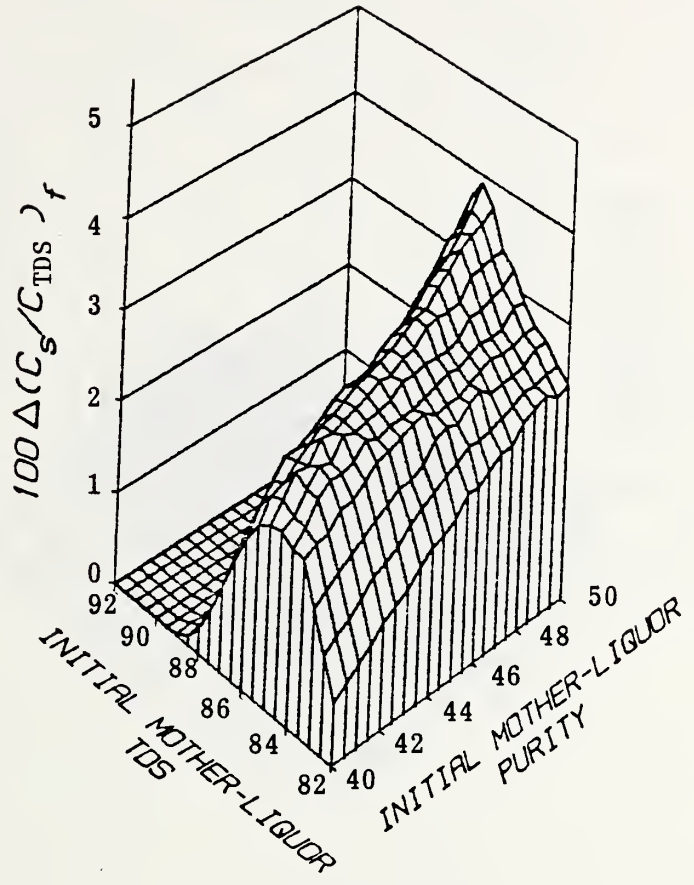

Figure 9: Effect of crystallizer capacity, COC cooling. Final molasses purity differential in a 10 hour-retention time crystallizer relative a 50-hour-retention time crystallizer. Highest loss occurs at the optimum operational parameters.

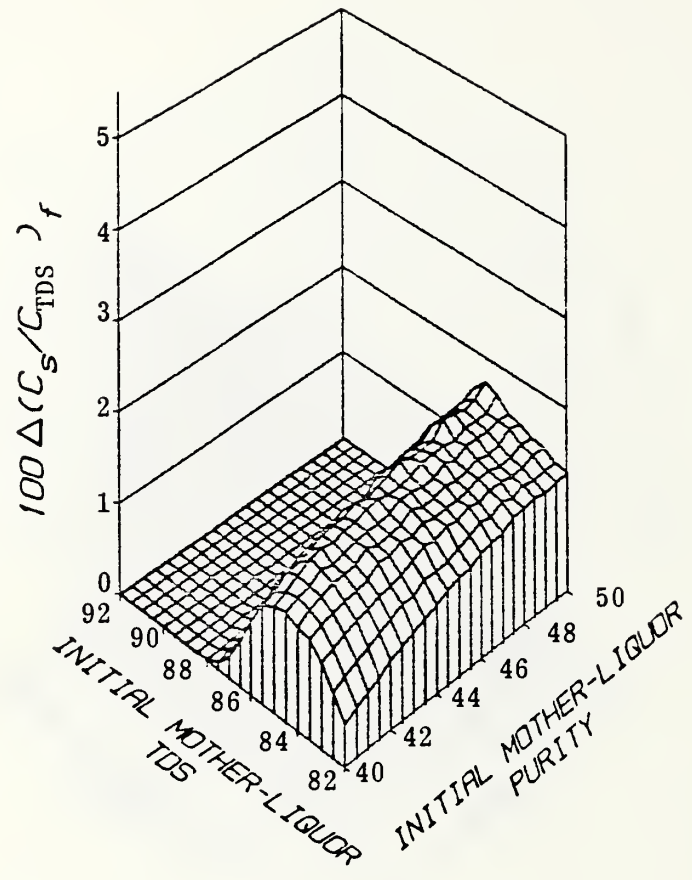

Figure 10:Effect of crystallizer capacity, COC cooling. Final molasses purity differential in a 20-hour retention time crystallizer relative a 50-hour retention time crystallizer.

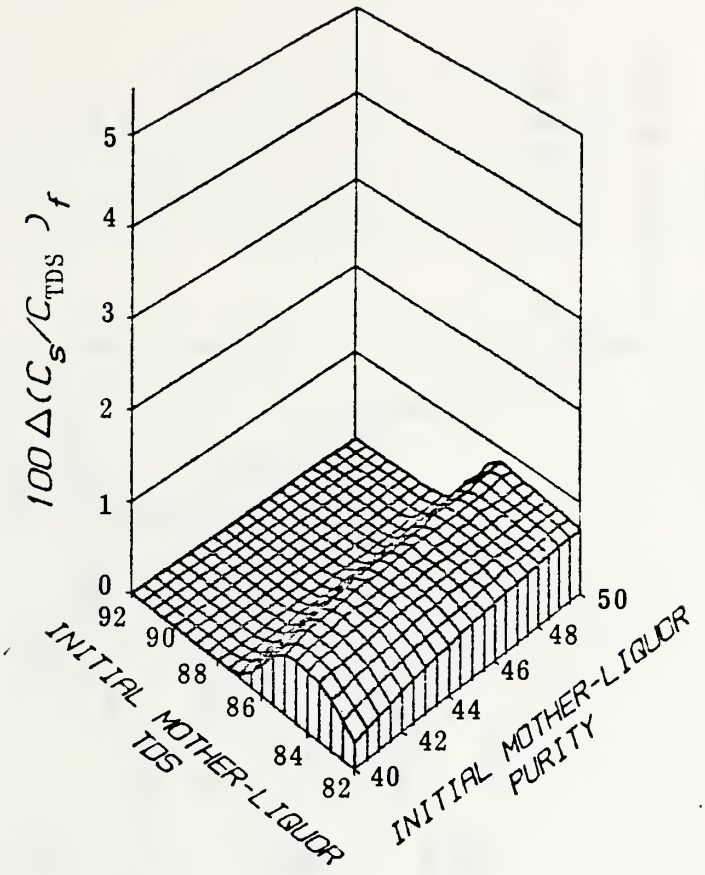

Figure 11:Effect of crystallizer capacity, COC cooling. Final molasses purity differential in a 30-hour retention time crystallizer relative a 50-hour retention time crystallizer.

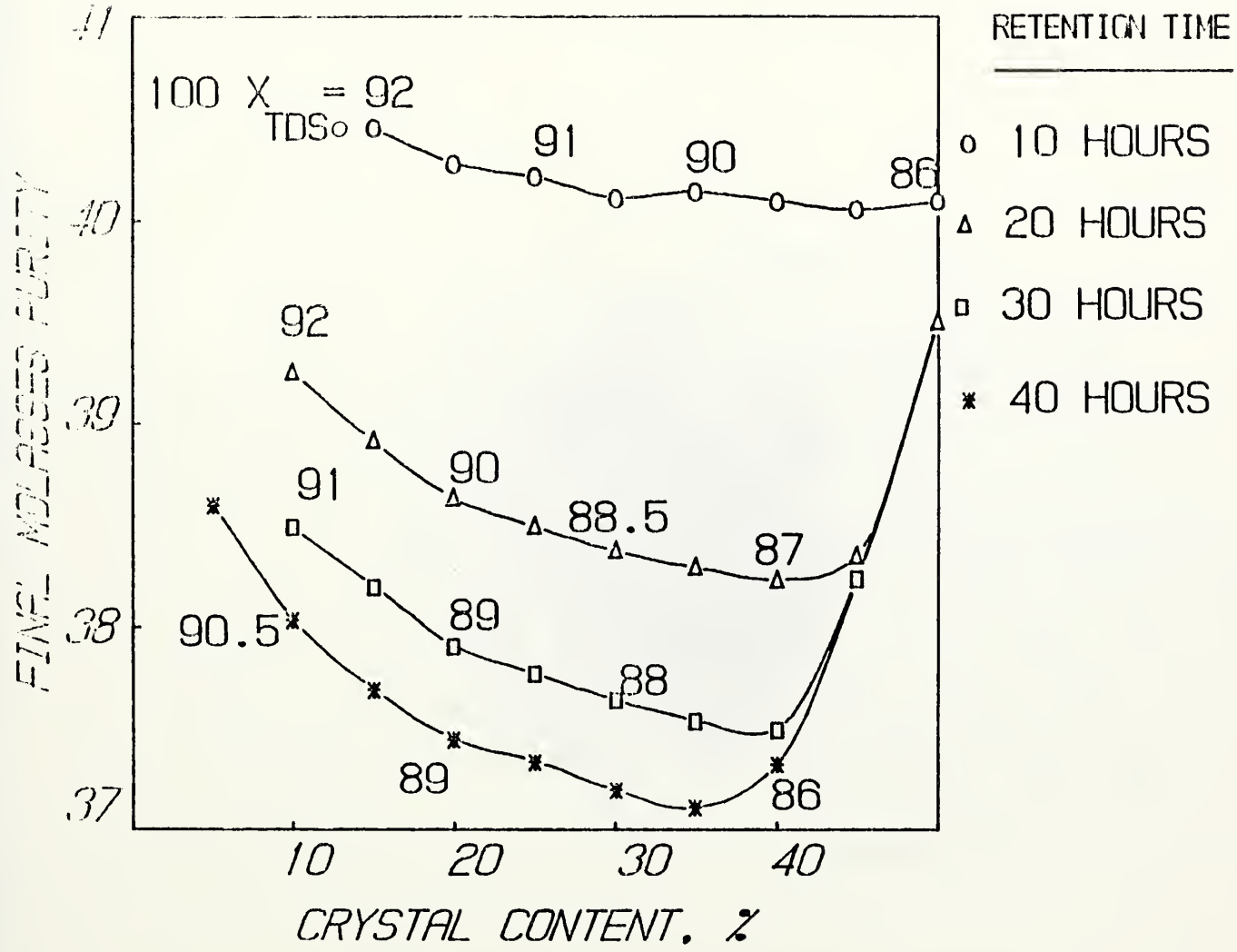

Figure 13: Effect of crystal content, for four crystallizer holding times 10, 20, 30 and 40 hours. COC cooling. The optimum level of crystal content depends on the crystallizer capacity, and lies between 35 and 45 %. The numbers at some of the points give the X_{TDSo} values resulting in the lowest final molasses purity for that particular crystal content and retention time.

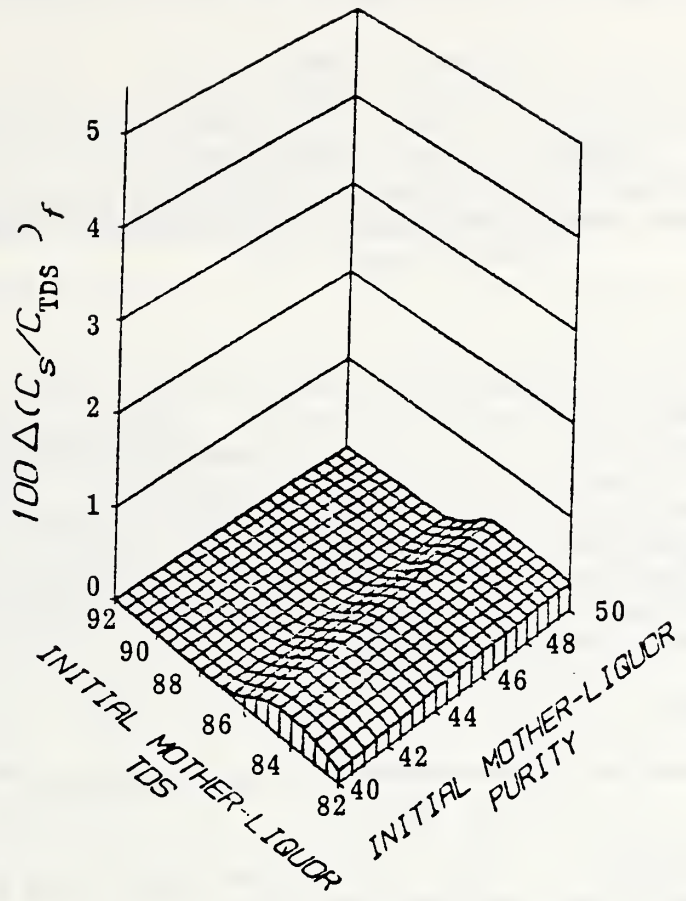

Figure 12: Effect of crystallizer capacity, COC cooling. Final molasses purity differential in a 40-hour retention time crystallizer relative a 50-hour retention time crystallizer.

COMPOSITION OF 1988 LOUISIANA FINAL MOLASSES

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As in previous years, samples of final molasses from participating Louisiana mills were analyzed for sucrose, reducing sugars (glucose and fructose), potassium and other components in order to provide a basis for the annual evaluation of exhaustion effectivness as well as a database for evaluation of long-term trends in exhaustion and molasses composition. Same as last year (1) two samples were collected and composited daily by the mills such that the first one represents an average over the first half and the second over the latter half of the grinding season.

ANALYTICAL METHODS

Brix was determined by refractometry of a 1:1 diluted sample at 20 C.

Total dissolved solids were calculated from the measured Brix by applying the empirical correction (2)

$$TDS = 100/(101.3/Bx + 0.00932/Suc)$$

where Bx and Suc are the Brix and sucrose concentrations in g per 100 g sample.

Sucrose, Glucose, Fructose were determined by liquid chromatography on a Waters' Sugar-Pak II analytical column (ion-exchange resin in Ca^{2+} form) at 85 C and a Waters' 410 RI detector . All three sugars were determined concurrently from injections of 20 microliters of solution (2g sample diluted to 1000 ml) filtered through 0.45 micron membrane. Other parameters: liquid phase: 50 ppm of $CaNa_2EDTA$ in distilled water, flow rate 0.5 ml/min, integration with a Spectra-Physics 4270 integrator/recorder.

Ash was estimated from the conductivity (Radiometer-Copenhagen) at 20 C of a solution of 2.00 g sample diluted to 200 ml volume with a low-conductivity distilled/de-ionized water. The ash content in grams per 100 grams of sample was calculated as (3)

$$0.0084\ K\ C + 0.8$$

Approved by the Director, Louisiana State University Agricultural Center as a publication #

where K is the cell constant (0.99 cm^{-1}) of the instrument and C, the measured conductivity in microsiemens.

Potassium content was determined by flame photometry of a solution prepared by digestion of a 2 % solution with nitric-perchloric acid reagent (4).

Sodium, Calcium, Magnesium, Iron, Phosphorus, Copper were determined by atomic absorption spectroscopy of a solution prepared as for determination of potassium.

TARGET PURITY was calculated from a formula

$$\text{TARGET TRUE PURITY} = 42.4 - 12.3 \, \text{Log}_{10}(\text{RS/ASH})$$

derived statistically (5) for Louisiana conditions.

RESULTS AND DISCUSSION.

The true purity of final molasses ranged from the low of 38 to over 51 % (TABLE I), with the average of 45.1 (Figure 1), slightly below the 1987 average of 45.4. The increase from last year in the content of reducing sugars (glucose + fructose), 16.8 and 12.8 % on average respectively and a slight decrease in ash concentration (12.6 and 13.9 for 1988 and 1987 respectively) combined to give a substantially higher reducing sugars/ash ratio of 1.33 compared to 0.92 last year. The ash composition (TABLE II) paralalled closely the last year's trend, potassium content ranged from 4 to close to 8 % Brix (average 5.5 %), calcium from 0.6 to over 1 % (average 0.90 %), magnesium from 0.4 to 1 % (average 0.56 %).

The molasses composition varied significantly among the mills, in particular the sucrose and reducing sugars contents. While the sucrose concentration (i.e. true purity) depends on the exhaustion efficiency and the mellasigenic properties of the non-sugars, the contents of the other components (glucose, fructose, ash, etc.) depend on the juice quality, clarification effects and chemical reactions throughout the process that either consume or produce the respective species. Thus for instance a low reducing sugars content may indicate either a mature sugarcane low in reducing sugars or a substantial degree of decomposition of the monosaccharides at high alkalinities and/or temperatures. A material balance on reducing sugars would then be required to answer which of these alternatives is responsible.

Of interest is the substantial difference in the content of fructose and glucose (4.8 % on average) which effects the (inherent) error of the polarimetry of low-purity sugar solutions (1) and makes it, despite its widespread use, unsuitable for control of the low-purity work and balancing of sucrose. Assuming that this excess is due, as suggested previously, to the bacterial break-down of sucrose and synthesis of glucans (dextrans and others) while fructose is left in solution, the fructose - glucose

difference of 4.8 % TDS corresponds (in terms of weight) to approximately 2 % of the total sucrose production and may thus indicate a serious economic loss. The lack of correlation found last year between this difference and the dextran content in the final molasses is understandable considering that only a (non-constant) fraction of dextran generated in the field and the factory ends up in final molasses. This difference may also be effected by the different rates of degradation in the process of glucose and fructose, with fructose being, generally speaking, more reactive than glucose. The occurence of dextran this year was considerable higher than in 1987 and this may be reflected in the somewhat larger fructose - glucose difference this year (4.8 %) than in 1987 (3.7 % on average).

The difference DIF (TABLE III) between the actual molasses purity and the target one varied from -1.3 (actual purity lower than target) to over 11 points with an average of 4.1 (2.4 last year). This excess represents a considerable economic loss to the industry equaling approximately 1 % of the total sugar produced and is worthy of increased attention. Little correlation is displayed when the actual true purity of final molasses is plotted against the reducing sugars/ash ratio (Figure 2), indicating that other factors, such as the massecuite Brix (6), the final cooling temperature (6) and centrifugation-related losses prevail in determining the final purity. The distribution of the actual purities around the target curve in Figure 2 confirms that the target purity equation, despite its simplistic nature, is a useful and realistic guide for evaluation of the factory performance.

The average final molasses purities over the last 8 years (Figure 3) demonstrate the reversal in 1984/1985 of the improving trend in molasses exhaustion. It is to be hoped that 1988 was the start of a permanent improvement cycle.

ACKNOWLEDGMENTS.

Appreciation is extended to the personnel of the Feed and Fertilizer Laboratory, Louisiana Agricultural Experiment Station, for the atomic absorption analyses.

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TABLE I: Composition of 1988 Louisiana final molasses. SUC = sucrose (= true purity), GLU = glucose, FRU = fructose,RS = reducing sugars (glucose + fructose), TSUG = total sugars, ASH = conductivity ash, RS/ASH = reducing sugars/ash ratio.

MILL-PERIOD	SUC [	GLU	FRU	RS	TSUG	ASH]	RS/ASH
			% T D S				
A-1	51.1	7.6	13.4	21.0	72.1	14.2	1.48
A-2	47.2	5.5	7.4	12.9	60.1	10.0	1.29
C-1	43.0	6.2	8.9	15.1	58.1	15.3	0.99
C-2	41.1	4.8	10.7	15.5	56.6	11.7	1.32
E-1	41.4	6.2	10.0	16.2	57.6	9.9	1.64
F-1	40.1	6.3	12.2	18.5	58.6	14.8	1.25
F-2	40.0	6.5	9.6	16.1	56.1	13.1	1.23
G-1	42.4	-	-	-	-	11.1	-
G-2	42.8	6.2	9.9	16.1	58.9	12.1	1.33
H-1	46.0	5.7	11.0	16.7	62.7	11.3	1.48
H-2	46.3	4.8	6.9	11.7	58.0	11.8	1.05
I-1	37.8	9.9	17.3	27.2	65.0	13.1	2.08
J-1	44.6	7.9	13.7	21.6	66.2	9.2	2.35
J-2	51.9	8.2	11.2	19.4	71.3	13.5	1.44
K-1	43.8	5.7	12.1	17.8	61.6	14.2	1.25
K-2	47.4	3.9	8.1	12.0	59.4	14.2	0.85
L-1	47.4	5.7	10.8	16.5	63.9	11.3	1.46
N-1	47.4	5.0	11.5	16.5	63.9	14.0	1.18
N-2	53.2	5.9	10.5	16.4	69.6	15.3	1.07
O-1	47.9	5.1	9.3	14.4	62.3	8.2	1.76
O-2	46.0	4.0	7.7	11.7	57.7	9.5	1.23
P-1	48.0	3.6	7.1	10.7	58.7	10.9	0.98
P-2	45.2	7.1	9.7	16.8	62.0	15.2	1.11
Q-1	42.5	4.2	7.4	11.6	54.1	10.4	1.12
Q-2	41.8	3.9	8.1	12.0	53.8	11.1	1.08
S-1	42.0	8.7	14.8	23.5	65.5	14.2	1.65
S-2	43.7	5.9	14.0	19.9	63.6	15.5	1.28
W-1	46.4	5.8	12.6	18.4	64.8	14.2	1.30
W-2	47.5	4.9	12.5	17.4	64.9	16.8	1.04

TABLE II: Ash composition of 1988 Louisiana final molasses. All in % Brix.

MILL-PERIOD	K	Ca	Mg	P	Na	Fe	Cu
				[	x 10,000		]
A-1	5.69	1.02	0.49	1168	626	173	16
A-2	7.74	1.14	0.59	1530	937	175	22
C-1	5.91	0.87	0.38	947	561	157	10
C-2	4.63	0.72	0.41	792	339	119	12
E-1	5.95	1.00	0.50	1300	582	172	13
F-1	4.90	0.74	0.60	823	535	125	10
F-2	4.23	0.67	0.66	1055	453	120	9
G-1	7.18	1.39	0.67	1419	494	217	31
G-2	5.41	0.96	0.45	864	342	172	24
H-1	6.31	1.06	0.57	934	498	192	15
H-2	5.77	0.77	0.49	725	573	120	12
I-1	7.38	1.43	1.07	2027	1612	632	37
J-1	4.25	0.62	0.52	935	356	185	22
J-2	4.75	0.68	0.61	977	523	138	11
K-1	5.20	0.82	0.47	1119	787	312	22
L-1	5.53	0.76	0.62	901	1572	125	9
N-1	4.46	0.72	0.51	704	796	195	15
N-2	5.06	1.08	0.60	828	899	180	20
O-1	4.70	0.53	0.36	824	2313	96	5
P-1	6.02	1.05	0.51	760	509	149	7
P-2	5.83	1.23	0.55	749	488	153	8
Q-1	5.63	0.86	0.59	1266	1501	168	13
Q-2	5.68	0.86	0.53	1243	1600	148	16
S-1	4.17	0.79	0.68	875	1238	103	15
S-2	5.36	0.93	0.41	1135	1855	94	14
W-1	5.96	0.59	0.76	1308	-	125	14

TABLE III: Approach to target purity. SUC = sucrose (= true purity), target = target true purity, dif = true purity - target true purity.

MILL-PERIOD	SUC [	TARGET % T D S	DIF]
A-1	51.1	40.3	10.8
A-2	47.2	41.0	6.2
C-1	43.0	42.5	0.5
C-2	41.1	40.9	0.2
E-1	41.4	39.7	1.7
F-1	40.1	41.2	-1.1
F-2	40.0	41.3	-1.3
G-2	42.8	40.9	1.9
H-1	46.0	40.3	5.7
H-2	46.3	42.1	4.2
I-1	37.8	38.4	-0.6
J-1	44.6	37.8	6.8
J-2	51.9	40.4	11.5
K-1	43.8	41.2	2.6
K-2	47.4	43.3	4.1
L-1	47.4	40.3	7.1
N-1	47.4	41.5	5.9
N-2	53.2	42.0	11.2
O-1	47.9	39.3	8.6
O-2	46.0	41.3	4.7
P-1	48.0	42.5	5.5
P-2	45.2	41.8	3.4
Q-1	42.5	41.8	0.7
Q-2	41.8	42.0	-0.2
S-1	42.0	39.7	2.3
S-2	43.7	41.1	2.6
W-1	46.4	41.0	5.4
W-2	47.5	42.2	5.3

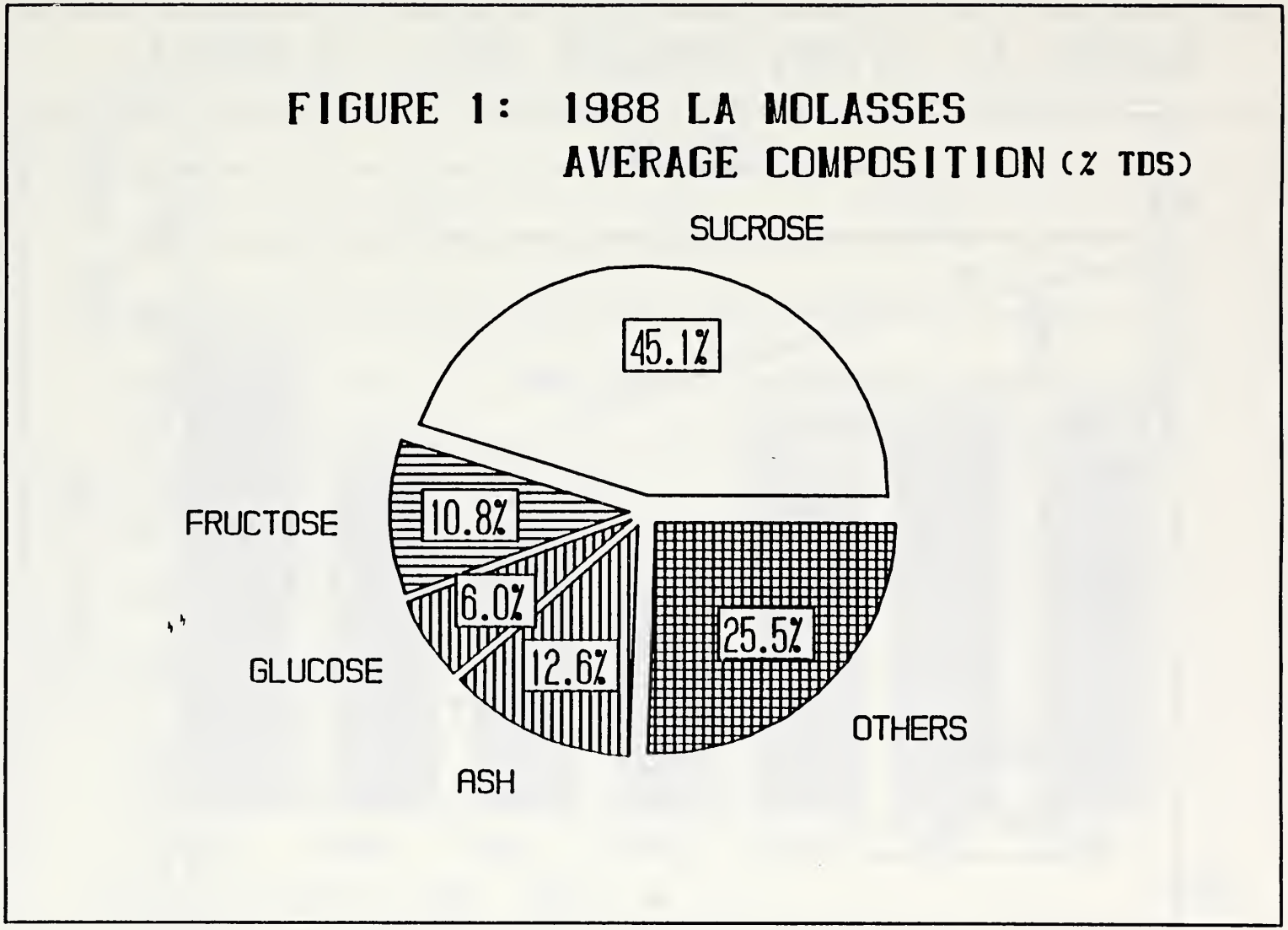
FIGURE 1: 1988 LA MOLASSES
AVERAGE COMPOSITION (% TDS)
SUCROSE
45.1%
FRUCTOSE
10.8%
6.0%
GLUCOSE
12.6%
ASH
25.5%
OTHERS

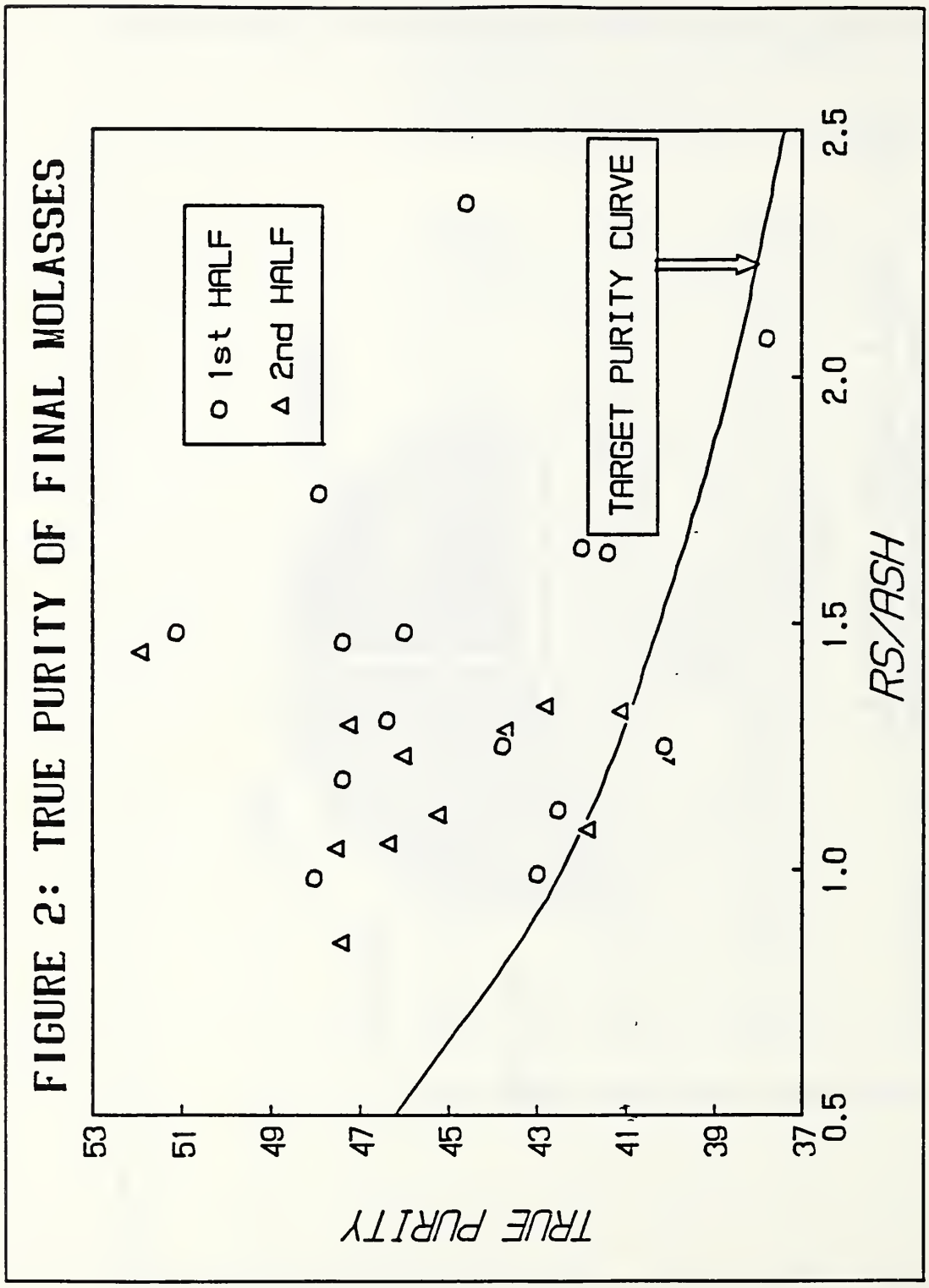
FIGURE 2: TRUE PURITY OF FINAL MOLASSES
o 1st HALF
Δ 2nd HALF
TARGET PURITY CURVE
TRUE PURITY
RS/ASH
53
51
49
47
45
43
41
39
37
0.5
1.0
1.5
2.0
2.5

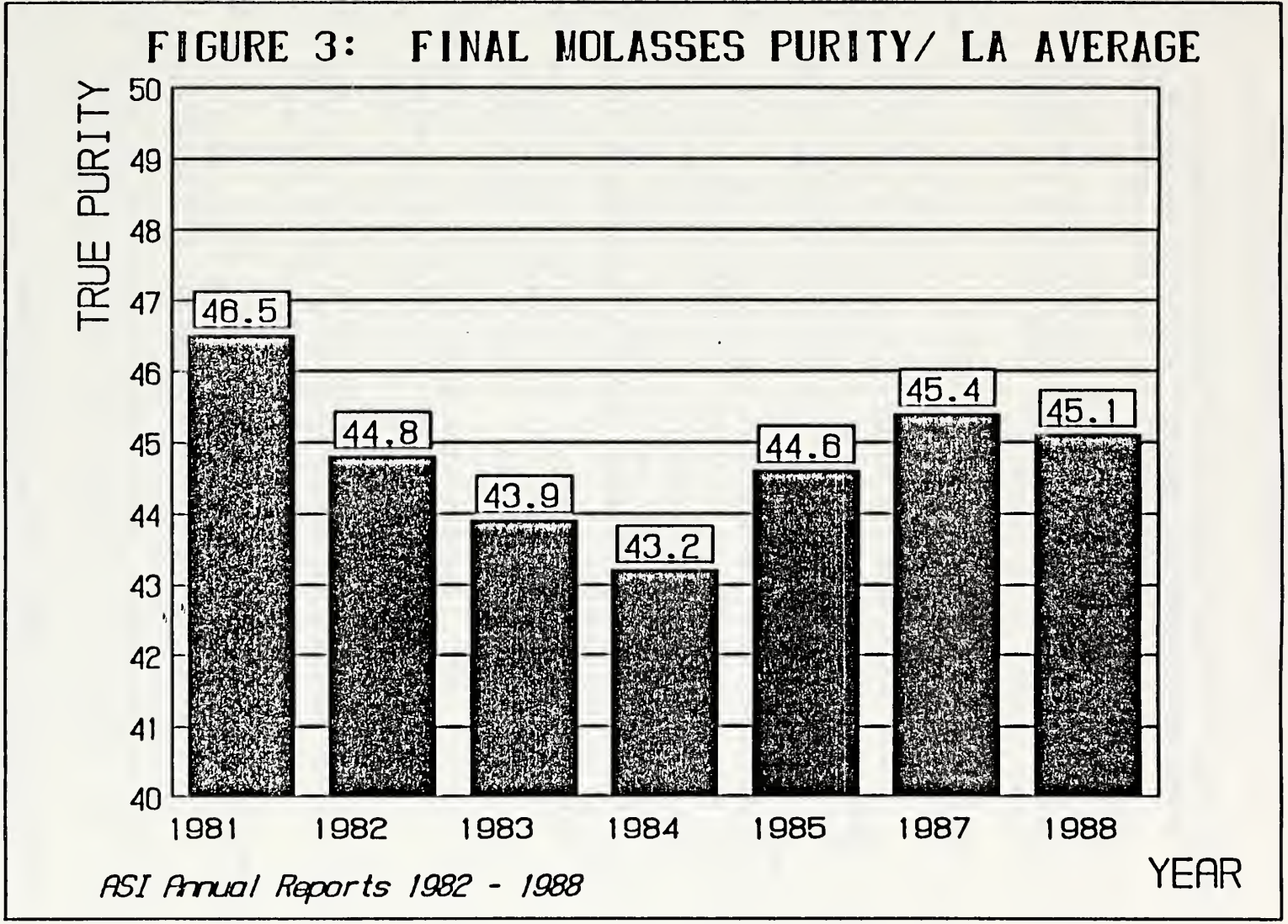
FIGURE 3: FINAL MOLASSES PURITY/ LA AVERAGE
TRUE PURITY
50
49
48
47
46
45
44
43
42
41
40
46.5
44.8
43.9
43.2
44.6
45.4
45.1
1981
1982
1983
1984
1985
1987
1988
YEAR
ASI Annual Reports 1982 - 1988

Projects Supported by the American Sugar Cane League in 1988

Economic Cost Structure of Sugar Cane Production in Louisiana
Project Leader: John G. Lee

Dextranase from Yeast--Continuation
Project Leader: Donal F. Day

Quick Core Lab Test for Dextran-Continuation
Project Leader: S. J. Clarke

Cane Sampling
Project Leader: Harold Birkett

Study of Crystal Growth Rate and False Grain Formation in Vacuum Pans and Crystallizer
Project Leader: Michael Saska

Automatic Vacuum Pan Control
Project Leader: W. Keenliside

Weed Control in Sugarcane
Project Leader: James L. Griffin

Investigation on the Role of Pythium Root Rot in Stubble Decline and Measures for its Control
Project Leader: J. W. Hoy

Equipment for Sugarcane Research
Project Leader: F. A. Martin

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